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ELECTRIC DISTRIBUTION.
BY RICHARD C. POWELL.

CAPITALIZATION OF WATER RIGHTS.

COST OF FINANCING UTILITIES.

PROPER VOLTAGE FOR UNDERGROUND TROLLEYS
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Alphabetical Index to Advertisers, Page 8 **Where to Buy It in the West, Page 9**

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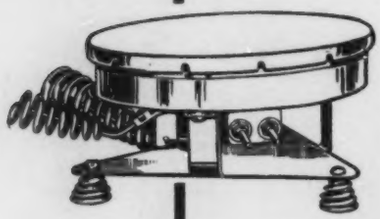

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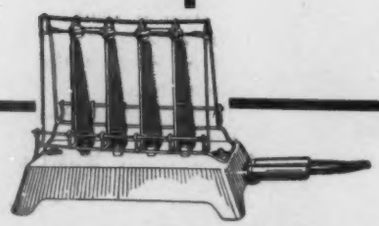

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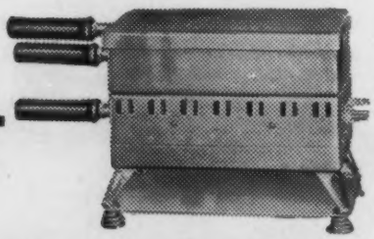

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ELECTRIC DISTRIBUTION

BY RICHARD C. POWELL

(In this article the author discusses the relative advantages of the different electric distribution systems, refers to their limitations and explains their use. In general, the article states succinctly those distribution requirements which must be considered in the rendering of satisfactory service. The author is superintendent of electrical distribution for the Pacilc Gas & Electric Company at Oakland, Cal.—The Editors.)

Main Feeders Leaving the Sub-Station.

The subject of this article, electric distribution, has come to be generally accepted as that branch of electrical engineering which is concerned with the delivery of electrical energy to the consumer from the station or sub-station where it is generated or received from a transmission system.

The writer will not attempt to go very much into details, but will cover in a general way some of the more important features of the subject, and although these are matters of common knowledge to those engaged in distribution work, it is hoped that others in somewhat different lines will also find herein much of interest.

To supply a large community, it is obvious that quite an extensive distribution system is required, the cost of which is apt to exceed that of the generating and transmitting equipment. We, therefore, find in the larger central stations a distribution department devoting itself exclusively to the construction and operation of the distribution system.

The perfection of alternating current distribution has made possible the central station of today, and its peculiar right to permanent existence as a public necessity is maintained by its distribution system, the means of gathering up and concentrating in one generating system all the load of a community. The

economy obtained by generating in large quantities is considerable, but the saving in capital and operating costs resulting from the so-called diversity of load is of great importance; for the capital which has been saved in power generating plants has been diverted to other enterprises, a matter of great economic value. Electrical energy can be transformed into every other form of energy and can be transmitted and distributed more economically. Upon this comparatively simple fact rests the broad foundation of the future central station. We shall expect the central stations eventually to supply all the energy, of whatever form, required within the area covered by its distribution lines.

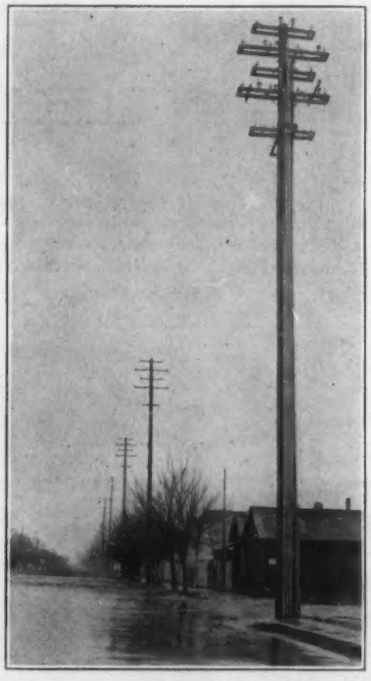
The work of the distribution engineer is to devise and construct lines to reach all classes of consumers, from the farmer with his intermittent irrigation load to the largest manufacturing establishments. It is evident that in these various classes of service are different requirements to be met, and in a large central station we should expect to find several types or forms of distribution.

In every industry there is an effort to lower the cost of the product, balanced however, by requirements as to quality. With the exception of certain special demands (for example, direct current is more suited to elevator work than alternating current), we

Distribution in a Commercial District.

find the quality of electric distribution to be judged by its voltage regulation and reliability or continuity of supply. The final judge is apt to be the consumer and we, therefore, naturally expect to find any given type of distribution to be somewhat of a balance between cost and what is demanded in the way of regulation and reliability.

The criterion for reliability is the voltage employed and the reliability varies inversely as the voltage, that is, the lower the voltage the greater the reliability. Further, we find in general the greater the density of load the more exacting are the consumers. Hence, we should expect the voltage employed to decrease when passing from a system supplying low load density to one supplying a higher density, and we find this to be the general present day practice. Also certain forms of construction have inherently better



The Leads Are Taken Underground.

qualities than others; for example, overhead distribution does not equal underground for reliability, and three-phase star circuits have better regulation than those delta connected.

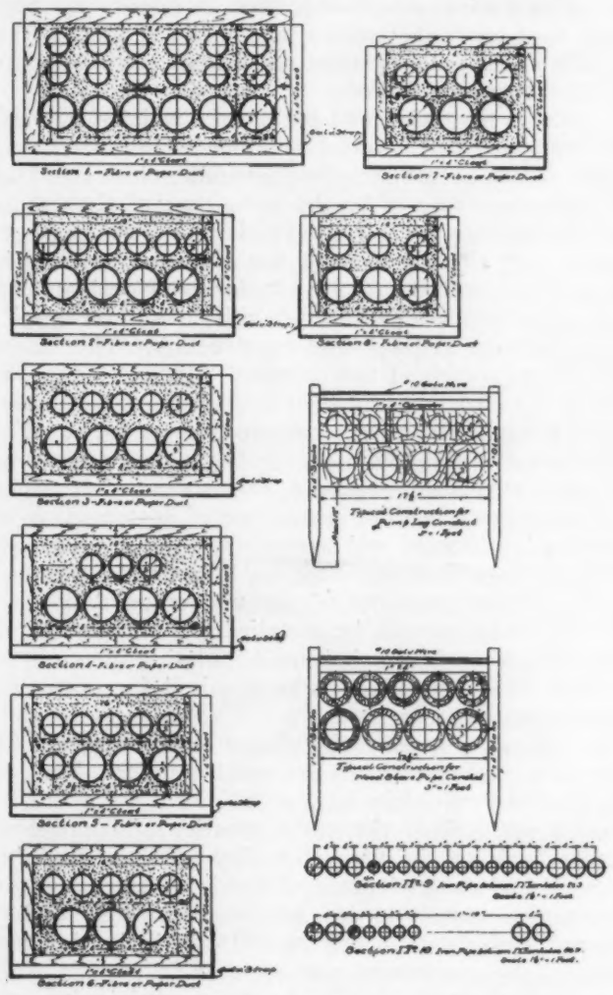
Consumers may be divided into four general classes, viz: rural, residential, commercial, and in the larger cities industrial.

The rural load is characterized by low annual load factor (sometimes not over 5 per cent) scattered over a large area with considerable distances between consumers. It is a power load and requires a low rate, which, together with the extremely poor load density, requires the cheapest form of construction compatible with safety and satisfactory operating of induction motors. In order to keep down the investment in copper (which is almost always bare) a voltage from 10,000 to 15,000 is used and in some cases 20,000 or over; short poles, (often 30 ft.) and long spans (200 ft. to 300 ft.) being the rule; sometimes iron wire is strung and in some cases ground return for single-phase has been employed. The use of ground in place of a conductor, however, is questionable practice and almost certain to prevent satisfactory operation of neighboring telephone lines.

On account of the length of circuits, the exposure to trouble is considerable and switches (air break) should be inserted at intervals to assist in clearing trouble and for convenience when working on the line. On branch lines supplying a single bank of transformers, the fuses would preferably be installed where the main line is tapped, rather than at the transformers.

When built with regard to mechanical details, and with insulators ample for the voltage employed, these higher voltage lines have proved very satisfactory for rural load.

The residential load varies from the small scattered loads in new real estate tracts to the comparatvely high density in the older and more solidly built



Sections Through Conduit Systems Used for Temporary Construction.

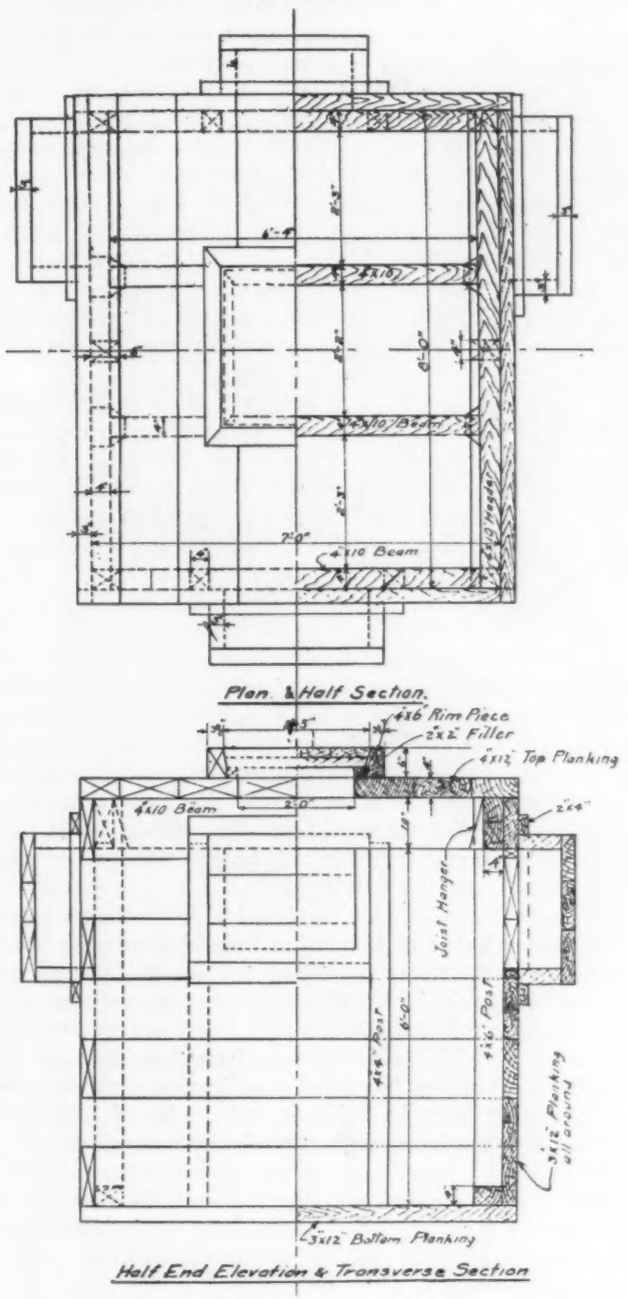
up sections which in addition to dwellings contain small business centers, apartment houses and small factories. Hence, certain circuits supplying a residential territory will have a considerable apartment house and commercial (small stores) load and also a fair day load from the small factories. The load factor for residential circuits will vary from 10 or 15 per cent for those supplying the more remote districts to 30 per cent for those feeding territory adjacent to the business section. The density of load in kw. per sq. mile of maximum feeder demand varies from 100 or 200 to 750 or possibly 1000 in the largest cities on the Pacific Coast.

It is advisable to use the same type of construction in the new real estate tracts as in the older portion of a city since, for most cities on the Pacific Coast, the new sections build up with remarkable rapidity.

For the residential load we must be prepared to furnish good service for we shall find many exacting consumers. We shall also find it profitable to encourage, as far as possible, an increased use of electricity in the residential sections, and it is evident we cannot expect to do this with poor service. Consumers must not be subjected to frequent or prolonged unsteadiness of voltage, or to voltage so low or so high that the life of lamps or quality of light is impaired. Finally, interruptions must not be frequent or protracted.

For this class of service the following general types are in more or less common use.

2 wire 2400 volt single-phase primaries with three-phase circuits for power.
3 wire 2400 volt, three-phase delta.
4 wire 4100 volt, three-phase star.
3 wire 6600 volt, three-phase delta.
4 wire 11000 volt, three-phase star.
3 wire 11000 volt, three-phase delta.
4 wire 2400 volt, two-phase.



A Manhole Made of Planking.

The secondaries for the three-phase systems are sometimes three-phase also, but the usual practice is to run a three-phase feeder to supply single-phase primary mains with single-phase three-wire second-

aries, stringing three-phase mains for power only. Where three-phase secondaries are the rule they may be either delta or star, preferably the latter, with 120 volts to neutral and 208 volts between wires. The disadvantages of continuing poly-phase distribution beyond the feeder are higher transformer costs and difficulty in maintaining the loads balanced; and unless the loads are kept balanced, the balancing currents will destroy any economy in transmission which three-phase has over single-phase. The small motors generally installed in residential districts are better taken care of by single-phase, extending three-phase for large installations only. Many central stations require a.c. motors of 3 h.p. or less, to be single-phase, and some raise the limit to 5 h.p.

Some of the advantages and disadvantages of the systems given above will be taken up.

The 2 wire, 2400 volt system has great reliability since the load per feeder is usually not more than 200 or 300 kw. and hence trouble on one feeder effects a comparatively limited number of consumers. The disadvantages are rather low voltage for economy, particularly for larger cities, and inability to combine power and lighting load, thereby loosing in so far as capacity is concerned, the gain due to great diversity of light and power load. With the present automatic feeder regulators it is no longer necessary to run separate circuits for power.

For the most part 2400 volt feeders are no more reliable than 4100 volt, 4 wire feeders with grounded neutral, since the same transformers are used and insulation strain on the line is the same to ground. The disadvantage in using 4100 volts may be in the temptation to get on too much load per feeder, thereby interrupting too many consumers when trouble appears on either the feeder or the mains, which is supplies.

With a single-phase regulator in each phase of a 4 wire feeder (either three-phase or two-phase) each phase may be regulated independently of the others for in practice the load can be quite evenly divided among the phases and therefore, the neutral drop is negligible. Since in delta circuits the loads are interconnected to the three phases, the regulation is not so good as in star, and for this reason the 4 wire star is preferable to the 3 wire delta.

Six thousand six hundred and 11,000 volt lines are much more liable to insulation breakdowns with consequent interruptions than 4100 volt lines. Transformers for 6600 and 11,000 volt service are more expensive, less free from breakdowns, and have poorer regulation than the 2400 volt type. The one advantage of the higher voltage lines for distribution work is the saving in copper, but this is apt to be of doubtful value particularly to any central station maintaining substations for supplying railway direct current. Such a central station can cover the distances between substations very nearly as economically with 4100 volts as with 11,000 volts and can certainly maintain much better service.

With 11,000 volts for city distribution the tendency is to cover too much territory, thus not only increasing the exposure to trouble but interrupting too much load on a feeder shut down. In addition to the above objections to 11,000 volts for this class of service, such lines cannot be worked upon alive and it is therefore, necessary to interrupt a portion of the load, at least, in order to cut in a transformer or otherwise work on the line; 4100 volt feeders limited to 300 kw. capacity for low density to 700 kw. maximum capacity are giving excellent service, particularly when oil switches are installed for separating or tying to primary mains supplied from adjacent feeder, or feeders.

The 4 wire two-phase system is inferior in economy to 4 wire, three-phase and is to be found principally in the older systems started before three-phase had become established.

The commercial load is that of a strictly business section made up of office buildings, department and other stores, hotels, etc. In the smaller cities this load is well taken care of by the same type of alternating current system, as for the residential load in larger cities. As the city grows, not only in size but in height and splendor, demands for improved appearance of streets and greater reliability of service require some form of underground construction. The standard form for this is the so-called "draw in" type, in which lead covered cables are pulled between manholes through clay, fibre or concrete ducts. The usual procedure at this stage of the city's development is to simply replace overhead construction by underground, preserving the same type of system, that is, overhead primaries and secondaries will be replaced by lead covered cable connecting by risers to overhead wires at the boundary of the underground district. The secondaries will be supplied by subway transformers placed in manholes. About this time, if not before, direct current will be required for operating elevators. In cities having a 500 volt d.c. street railway system, a commercial power feeder supplied by the railway generators is the usual practice. Most of the Pacific Coast cities have a 500 volt d.c. power system, a survival of the early practice of connecting power loads to the nearest trolley. As the load increases, and the underground district is extended, the alternating current feeders are placed entirely underground to the station and the 500 volt d.c. feeders are supplied by generators not operated in parallel with railway generators, that is, the commercial feeders are operated as a system independent of the railway.

The proceeding is descriptive of cities growing up at the present time or in the larger cities in which electric plants were installed subsequent to the development of alternating current distribution. In the older cities Edison d.c. 3 wire, 220-110 volt systems were first used, and these have been extended so that we find most of the older cities on the Pacific Coast operating 220 volt, 3 wire d.c. systems to supply the dense commercial loads. In the early days, the loads were small with correspondingly small conductors, so that the starting of elevators or other comparatively large motors was apt to considerably disturb the lighting service. For this reason 500 volt d.c. from the railway system was distributed for the power loads. However, as the 220 volt system grew, it was able to absorb the power incident to a business district without detriment to the lighting service.

Hence, in the older and larger cities, we find practically all the commercial load on the 220 volt d.c. system, the 500 volt d.c. being maintained to handle the load not convenient, or economical to change to 220 volts.

The Edison 3 wire system was about the earliest type of electric distribution, and at the present time is still maintained in our largest cities. It is therefore, being depended upon to take care of the densest loads and where extreme reliability is demanded by those consumers to whom any interruption of service whatever is intolerable and might lead to the installation of an isolated plant. This system probably owes its continuation and extension, more to general excellence than to any fact of priority. Today it is essentially the same as when first installed by Edison, and remains the system par-excellence for dense commercial loads which in some of the very large cities exceeds 7500 kw. per sq. mile.

Low voltage (not over 250 volts) d.c., underground systems, will probably be, for many years to come if not for all time, the most reliable means of distributing electricity, though its cost will limit its use to heavy commercial service. The voltage employed is so low that the question of insulation is a simple one, and in many cases only a slight mechanical separation is sufficient.

Direct current has a marked advantage over alternating, for extensive network distribution. It would be a very difficult matter to so adjust and maintain the capacity and reactance in a network, so that, so-called "circulating currents" would not flow, with attendant loss in efficiency and voltage regulation. With direct current the currents dividing inversely as the resistances of the various branches of the network, in a certain measure force the cables automatically to divide load in proportion to their capacities.

The branches of the network are connected together through copper link fuses. The feeders are connected to the station bus through switches and to the mains with fuses. Thus trouble in any branch is automatically cleared by the blowing of its fuses and without disturbance to the system as a whole. No more expensive and dependable devise than the short link copper fuse can be imagined, but unfortunately its use is limited to low voltages.

Finally, by connecting standby storage batteries to the 220 volt, 3 wire, d.c. system, uninterrupted service is insured against station shut downs, or accidents imparing station capacity.

The feeders are usually not larger than 1,000,000 c.m. and carry maximum loads of approximately 200 kw.

It is customary in d.c. practice to connect wires to the network at various points and run them back to the station and arranged for connection to a voltmeter or voltmeters. The station operator is then in a position to know if the proper voltage is being delivered.

When load is thrown on a direct current network, each branch or element takes up some portion of that load, so that in practice it is rare to meet with suddenly applied loads of sufficient magnitude to disturb the system in any way. For this reason automatic regulation is not necessary.

Smaller systems have the feeders connected to a single bus, the bus voltage being raised as the load comes on. The larger systems have from 2 to 5 buses maintained at different voltages over the peak. The voltage of the highest bus will be that sufficient to give correct voltage at the end of the longest, or heaviest loaded feeders; the lowest bus will be held at sufficient voltage to give proper service on the shortest, or lightest loaded feeder, while the other buses will be at various intermediate voltages.

As the load comes on, those feeders supplying a vicinity showing dropping voltage by the pressure wire volt meters are transferred to a higher voltage bus.

In the average city the industrial load is so intermingled with the residential and connected to these circuits that it is not taken care of separately. However, at times very large shops and factories having loads of several thousand kw. are supplied with central station power. These large loads are rather to be considered as substations, and are undoubtedly better handled as such. The standard voltage between stations and substations should be employed to avoid station or substation transformation losses. Usually the consumer will demand a duplicate line or standby service of some sort to insure him against shut down.

In Some Residential Districts Underground Distribution Is Essential.

A new method of destroying teredos, a borer pest which has caused enormous damage in the destruction of piles used in wharfage construction in North Pacific Coast ports, particularly in Vancouver, Seattle and Tacoma, by turning an electric current into the piles, is being tried in Seattle. These pests have so far successfully defied all attempts to eradicate them from the timbers supporting the various structures along the water front in the Puget Sound and British Columbia ports, and a means of destroying them will prove a great saving to individuals and companies maintaining docks and wharfage properties on the coast.

SUPREME COURT DECISION REGARDING CAPITALIZATION OF WATER RIGHTS.

THE SAN JOAQUIN AND KINGS RIVER CANAL & IRRIGATION COMPANY, INCORPORATED.

Appellant.

vs.

THE COUNTY OF STANISLAUS, IN THE STATE OF CALIFORNIA, *et al.*

Appeal from the Circuit Court of the United States for the Northern District of California.

(April 27, 1914.)

Mr. Justice Holmes delivered the opinion of the court.

This is a bill to restrain the enforcement of orders, passed by the boards of supervisors of the three defendant counties, Stanislaus, Fresno and Merced, establishing water rates to be charged by the plaintiff, the appellant; the ground of the bill being that the orders deprive the plaintiff of its property without due process of law. By a statute of March 12, 1885, the boards are authorized to fix these rates for their several counties, but so that the returns to the parties furnishing the water shall not be less than 6 per cent upon the value of the "canals, ditches, flumes, chutes, and all other property actually used and useful to the appropriation and furnishing of such water." The rates when fixed are binding for one year and until established anew or abrogated. The bill concerns rates fixed in 1907, and the question before the court has been narrowed to a single issue. If the plaintiff is entitled to 6 per cent upon its tangible property alone it is agreed that the orders must stand. But if the plaintiff has water rights that are to be taken into account, the rates fixed will fall short of giving it what it is entitled to and must be set aside. The Circuit Court dismissed the bill, 191 Fed. Rep. 875, and on this appeal figures are immaterial, the only question being whether the principle adopted is right.

It was suggested to be sure at the argument that it does not appear that the plaintiff offered any evidence as to water rights at the hearing before the supervisors, and therefore that it ought not to be allowed to complain now that nothing was allowed for them. But this evidently is an afterthought. In general, a party may wait until a law is passed or regulation is made and then insist upon his Constitutional rights. Prentis v. Atlantic Coast Line Co., 211 U. S. 210, 227, 229. This we understand to be the view of the California courts as to these very boards. Spring Valley Water Works v. San Francisco, 82 Cal. 286, 315. San Diego Water Co. v. San Diego, 118 Cal. 558, 564. Moreover as the defendants contend that the plaintiff is entitled to no compensation for water rights, to offer evidence would have been an idle form.

It is not disputed that the plaintiff has a right as against riparian proprietors to withdraw the water that it distributes through its canals. Whether the right was paid for, as the plaintiff says, or not, it has been confirmed by prescription and is now beyond attack. It is not disputed either that if the plaintiff were the owner of riparian lands to which its water was distributed it would have a property in the water that could not be taken without compensation. But it is said that as the plaintiff appropriates this water to distribution and sale it thereby dedicates it to public use under California law and so loses its private right in the same. It appears to us that when the cases cited for this proposition are pressed to the conclusion reached in the present case they are misapplied. No doubt it is true that such an appropriation and use of the water entitles those within reach of it to demand the use of a reasonable share on payment. It well may be true that if the waters were taken for a superior use by eminent domain those whose lands were irrigated would be compensated for the loss. But even if the rate paid is not to be determined as upon a purchase of water from the plaintiff, still, at the lowest, the plaintiff has the sole right to furnish this water, the owner of the irrigated lands can not get it except through the plaintiff's help, and it would be unjust not to take that fact into account in fixing the rates. We are not called upon to decide what the rate shall be, or even the principle by which it shall be measured. But it is proper to add a few words.

The declaration in the Constitution of 1879 that water appropriated for sale is appropriated to a public use must be taken according to its subject matter. The use is not by the public at large, like that of the ocean for sailing, but by certain individuals for their private benefit respectively. Thayer v. California Development Co., 164 Cal. 117, 128. Fallbrook Irrigation District v. Bradley, 164 U. S. 112, 161. The declaration therefore does not necessarily mean more than that the few within reach of the supply may demand it for a reasonable price. The roadbed of a railroad is devoted to a public use in a stricter sense, yet the title of the railroad remains, and the use though it may be demanded, must be paid for. In this case it is said that a part of the water was appropriated before the Constitution went into effect, and that a suit now is pending to condemn more as against a riparian proprietor, for which of course the plaintiff must pay. It seems unreasonable to suppose that the Constitution meant that if a party instead of using the water on his own land, as he may, sees fit to distribute it to others he loses the rights that he has bought or lawfully acquired. Recurring to the fact that in every instance only a few specified individuals get the right to a supply, and that it clearly appears from the latest statement of the Supreme Court of California, Palmer v. Railroad Commission, January 20, 1914, that the water when appropriated is private property, it is unreasonable to suppose that the constitutional declaration meant to compel a gift from the former owner to the users and that in dealing with water "appropriated for sale" it meant that there should be nothing to sell. See San Diego Water Co. v. San Diego, 118 Cal. 556, 567. Fresno Canal & Irrigation Co. v. Park, 129 Cal. 437, 443, et seq. Stanislaus Water Company v. Bachman, 152 Cal. 716. Leavitt v. Lassen Irrigation Co., 157 Cal. 82.

Decree Reversed.

Gas has influenced London fog conditions, said Prof. V. B. Lewes, in his lecture on "The Hygienic Value of Coal Gas as an Illuminant and a Fuel," given at the recent Manchester (England) Gas Conference. The wide introduction of the gas stove in London is responsible for this. One-sixth of the chimneys, he stated, have ceased to add their quota of smoke to the atmosphere, and the registers show more hours of sunlight, while the cleansing of the fog is a still more marked result.

COST OF FINANCING UTILITIES.

(This article on the high cost of obtaining money for extensions and improvements to California public utilities is abstracted from an affidavit filed in the U. S. District Court by A. F. Hockenbeamer vice-president and treasurer of the Pacific Gas & Electric Company, in a rate suit instituted by his company against the city and county of San Francisco.—The Editors.)

Compelled Utility Expenditures.

Gas and electric companies are compelled, under the laws of the State of California, to render satisfactory and adequate service, and to extend their facilities to all residents within the territory served who may be located within 100 ft. of mains or distribution lines. Refusal or neglect to supply gas or electricity within ten days after application makes them liable for the payment to the applicant of $50 as liquidated damages, and of $5 per day as liquidated damages for every day such refusal or neglect continues thereafter.

The municipalities of the state possess and frequently exercise, the power of compelling gas and electric companies to incur other large expenditures in placing their distribution facilities under ground and in accommodating existing facilities to changes in street lines, changes in or the construction of new sewers, water pipes and other civic improvements.

Within the last two years the Constitution of the state has conferred upon the Railroad Commission of California broad powers for compelling extensions and betterments of facilities, and of enforcing higher standards of service and safety.

The investment of vast sums is not a matter of choice. The utility cannot choose to stand still and escape the law's penalties by pleading lack of funds, but must take its securities into the money markets of the world, when and as necessary, and secure at whatever cost is necessary, the large amounts of new capital required by it.

Capital Required for Obligations Maturing.

In addition to the large sums of money required for betterment and extension, large amounts of new capital must be raised for the purpose of paying maturing obligations.

Owing to the inability of companies to realize from the sale of authorized bonds the par value thereof, they are compelled, from year to year, to find large sums of money, other than from the proceeds of the sale of its bonds, to pay for the difference between the actual cost of new construction and the amount realized or to be realized from the sale of bonds. The railroad commission will not permit the money necessary for meeting this so-called "bond account" to be raised through the sale of securities, and it must, therefore, be taken from the earnings of the companies. While this so-called "bond discount," as a matter of accounting, is amortized over the life of the bonds, it is, nevertheless, an obligation which must be met in cash at the time the construction work is done.

Bond quotations in the securities market afford no indication whatever of the rate of return upon the fair value of the properties that will permit companies to secure the large amounts of new capital required from time to time to carry on their enterprise and to fulfill the obligations imposed with respect to giving service to the inhabitants of the territory served and to yield to the owners of the utility an adequate return commensurate with the hazards attendant upon the inauguration and conduct of the enterprise.

Status of Gas and Electric Investments.

Investors will purchase the bonds of municipalities, at prices which yield to them a less return than they are willing to accept upon investments in the bonds of gas and electric companies. They will also purchase the bonds of well established steam railroads, at prices that will yield to them a less return than they are willing to accept upon investments in the bonds of gas and electric companies, for the reasons, among others, that the business of steam railways has been established upon an investment basis many years longer than the business of gas and electric companies; that the steam railroad business is less subject to destructive competition, and that the securities of steam railroad companies, under the laws of divers states, have been legalized for the investment of trust funds, savings banks, and other investment institutions which are not permitted under such laws to purchase the bonds of gas and electric companies.

There is a vital distinction between so-called "closed issues" and "open issues" of bonds of public utility corporations. The term "closed issue" means that no more bonds may be issued under the terms of the indenture securing such bonds. It follows that when the supply ceases the continued demand usually raises the level of prices of such bonds. The closing of a bond issue also results almost invariably in increasing the safety of such bond issue by reason of the fact that the value of the property to secure it is increased through the application of funds derived from the sale of stocks or bonds which are junior to the closed issue. There is no escape from the creation of such a condition when the utility operates in a growing territory and is alive to the obligations imposed upon it to serve the public. In addition to the larger equity thus created for the holders of the "closed issue," the purchaser of such underlying closed issue also has the assurance that the obligation held by him must be protected by the owners of the junior obligations. As a means of raising new capital closed issues are of no benefit to the utility and the citation, therefore, of the market prices of closed bond issues, as indicative of the cost of money to utilities or as evidence that money in large amounts can be secured on approximately the terms indicated by the market quotations of closed bond issues, is illogical and without support in fact.

The Cost of Capital.

Market quotations of bonds based on transactions between investors do not correctly indicate the cost to the utility of new capital required in the growth and development of its enterprise. It is not practicable for it to obtain this new capital through the sale of securities in small amounts directly to investors. Before proceeding with the execution of larger plans of development, assurance must be given in advance that the money required will be available when needed. Companies must, therefore, dispose of bonds at wholesale to investment bankers having at their disposal the necessary capital or banking credit to pay for the bonds in cash when delivered.

The cost to gas and electric companies of authorizing, issuing and marketing their bonds in the usual and customary manner, including the compensation of trustees under the mortgages, fees of counsel, commissions paid to bankers, and official fees required by the Public Utilities Act to be paid to the Railroad Commission of California will rarely, if ever, be less than five, and frequently amounts to ten per cent or more of the par value of the bonds.

A distinction must be made between the stockholders of a public utility and its bondholders and between two things that are fundamentally different, namely:

(a) What is a reasonable and fair rate upon investments made by a corporation in acquiring or directing or operating its properties for public purposes, and

(b) The rate of interest at which a public utility corporation can borrow a limited portion of the capital necessary in the conduct of its enterprise.

The borrowing of money by a utility, whether it be through the sale of bonds or otherwise, is merely an incident of management and the rate at which it is able to borrow money is not a fair measure of the compensation that should be allowed to the owners of the utility to compensate them for the risks of the business and for the liability which they assume in protecting the creditors from whom the money is borrowed.

Stockholders and Bondholders Differentiated.

There is a fundamental difference between the stockholders of a public utility and its bondholders; that the former are partners in the enterprise while the latter are merely creditors; the former assume all the risks of the business while the latter merely loan money secured by the stockholders' property. The rate of return which would be attractive to a bondholder, who is a creditor entitled to repayment of a definite sum of money at a definite time with interest thereon, secured as to repayment of the principal of his obligations by the pledge of specific property and further protected by the liability of the stockholders for the debts of the utility, is not the rate of return which would tempt investors to engage as owners in any line of business, public utility or otherwise, assuming as they necessarily would, not only the hazards attendant upon the inauguration and conduct of the enterprise but an absolute obligation to pay the debts of the corporation. If to the owners of the enterprise there is not accorded a larger return than to its creditors capital cannot be found in large volume to undertake the burden of public utility financing, construction and operation.

The Tabulated Bond Issues.

The accompanying table shows issues of bonds of gas and electric companies operating within California, which the railroad commission has authorized since the public utilities act became effective on March

BOND ISSUES OF CALIFORNIA GAS AND ELECTRIC COMPANIES.

Name of Issuing Utility.	Description of Bonds.	Unexpired Life of Bonds.	Total Par Value Authorized by Commission.	Date Authorized by Commission.	Sale Price Authorized by Commission.	Approximate Yield Per Annum to Investors if Held to Maturity.
Holton Power Co	First and Refunding 6%	39 Years	$ 300,000	July 3, 1912	.80	7.9 %
Indian Valley Elec. L. & Power Co	First 6%	40 Years	81,535	Aug. 23, 1912	.80	7.9 %
Mt. Whitney Power & Electric Co	First Mortgage 6%	27 Years	250,000	Nov. 18, 1912	.95	6.39%
Northern California Power Co. Con	Debenture Notes 6%	5 Years	500,000	Aug. 14, 1912	.96	6.96%
Pacific Gas & Electric Co	General and Refunding 5%	29 Years	5,000,000	Sept. 14, 1912	.85	6.09%
San Diego Cons. Gas & Electric Co	First Mortgage 5%	27 Years	250,000	Sept. 4, 1912	.94	5.43%
San Joaquin Light & Power Corp	First and Refunding 5%	38 Years	925,000	Nov. 26, 1912	.87	5.80%
Santa Barbara Gas & Electric Co	First Mortgage 6%	29 Years	5,000	Sept. 7, 1912	.95	6.38%
Santa Maria Gas & Power Co	6%	15 Years	50,000	July 30, 1912	1.00	6. %
Southern California Utilities Co	6%	30 Years	10,000,000	Nov. 13, 1912	.9675	6.24%
Southern Counties Gas Co	First Mortgage 6%	29 Years	47,000	Oct. 14, 1912	.85	7.23%
West Coast Gas Co	6%	40 Years	100,000	Nov. 5, 1912	.80	7.9 %
Western States Gas & Electric Co	First and Refunding 5%	28 Years	351,000	June 7, 1912	.875	5.92%
Western States Gas & Electric Co	First and Refunding 5%	28 Years	600,000	Sept. 20, 1912	.875	5.92%
West Coast Gas Co	First Mortgage 6%	40 Years	250,000	Nov. 5, 1912	.80	7.9 %
Indian Valley Elec. L. & Power Co	Notes 7%	.....	.....	Aug. 25, 1912	1.00	7. %
Imperial Valley Gas Co	First Mortgage 6%	17 Years	154,600	Jan. 8, 1913	.80	8.12%
Western States Gas & Electric Co	First and Refunding 5%	28 Years	397,000	Jan. 10, 1913	.885	5.84%
Southern California Edison Co	General Mortgage 5%	27 Years	2,500,000	Jan. 27, 1913	.92	5.58%
San Diego Cons. Gas & Electric Co	First Mortgage 5%	26 Years	204,000	Feb. 11, 1913	.95	5.34%
City Electric Co	First Mortgage 5%	25 Years	833,000	Feb. 24, 1913	.84	6.25%
Southern Counties Gas Co	First Mortgage 6%	28 Years	5,500	Mar. 1, 1913	.85	7.2 %
Great Western Power Co	First Mortgage 5%	33 Years	4,411,000	Mar. 11, 1913	.90	5.56%
Los Angeles Gas & Electric Corp	First and Refunding 5%	26 Years	900,000	Apr. 10, 1913	.945	5.38%
Sacramento Natural Gas Co	First Mortgage 6%	28 Years	193,000	Apr. 24, 1913	.95	6.39%
Mt. Whitney Power & Electric Co	First Mortgage 6%	26 Years	250,000	Apr. 25, 1913	.95	6.40%
Southern Counties Gas Co	First Mortgage 6%	28 Years	8,000	May 3, 1913	.85	7.2 %
Pacific Gas & Electric Co	Debenture 6%	10 Years	5,000,000	May 15, 1913	.95	6.69%
Southern Counties Gas Co	First Mortgage 6%	28 Years	4,000	June 11, 1913	.85	7.2 %
San Diego Cons. Gas & Electric Co	First Mortgage 5%	26 Years	180,000	June 30, 1913	.85	6.21%
Beaumont Gas & Power Co	Notes 8%	5 Years	5,000	July 2, 1913	1.00	8. %
Economic Gas Co	First Mortgage 5%	28 Years	270,000	July 10, 1913	.83 1/3	6.35%
Santa Barbara Gas & Electric Co	First Mortgage 6%	28 Years	100,000	July 10, 1913	.95	6.39%
California Telephone & Light Co	First Mortgage 6%	30 Years	350,000	June 17, 1913	.94	6.42%
San Joaquin Light & Power Corp	First and Refunding 5%	37 Years	1,776,000	July 12, 1913	.80	6.50%
Southern Counties Gas Co	First Mortgage 6%	28 Years	75,000	Aug. 6, 1913	.85	7.2 %
Western States Gas & Electric Co	First and Refunding 5%	27 Years	354,000	Aug. 30, 1913	.885	5.83%
Western States Gas & Electric Co	First and Refunding 5%	27 Years	75,000	Oct. 2, 1913	.825	6.35%
Midland Counties Public Serv. Corp	First Mortgage 6%	40 Years	1,559,000	Oct. 1, 1913	.92	6.55%
Pacific Gas & Electric Co	Gold Notes 6%	1 Year	7,000,000	Sept. 24, 1913	.955	10.75%
Sonoma Valley Light & Power Co	First Mortgage 6%	30 Years	30,000	Sept. 30, 1913	.825	7.4 %
Amador Light & Power Co	First Mortgage 6%	16 Years	12,000	Oct. 2, 1913	1.00	6. %
Hemet-San Jacinto Gas Co	First Mortgage 6%	13 Years	3,000	Oct. 8, 1913	.825	7.1 %
Napa Valley Electric Co	First Mortgage 6%	17 Years	20,500	Oct. 14, 1913	1.00	6. %
San Diego Cons. Gas & Electric Co	First Mortgage 5%	26 Years	27,000	Oct. 29, 1913	.85	6.21%
Coast Valleys Gas & Electric Co	First Mortgage 6%	38 Years	114,000	Oct. 30, 1913	.90	6.75%
San Diego Cons. Gas & Electric Co	First Mortgage 5%	26 Years	41,000	Nov. 14, 1913	.85	6.21%
California Telephone & Light Co	First Mortgage 6%	30 Years	100,000	Nov. 21, 1913	.94	6.46%
Mt. Whitney Power & Electric Co	First Mortgage 6%	26 Years	250,000	Dec. 5, 1913	.95	6.40%
Coachella Valley Ice & Electric Co	6%	31 Years	300,000	Dec. 13, 1913	.80	7.6 %

23, 1912, down to approximately the present time. This shows the names of the issuing utilities, the title of each bond issue and the annual rate of interest paid thereon, the approximate unexpired life of each bond issue, the total par value of each of the bond issues so authorized by the commission, the date of the commission's authorization, the minimum sale price authorized by the commission and Mr. Hockenbeamer's calculation of the approximate yield per annum to the purchasers of each bond issue so authorized if held to the maturity thereof.

This is indicative of the prices at which the gas and electric companies of California are able, or hope to be able, to borrow money on the security of their property. The calculated rates of return to the purchasers of these bonds do not indicate the rates of return that must be allowed to utilities to enable them to earn the interest rates shown and a sufficient margin of profit over and above such interest rates to establish their credit and consequent ability to dispose of these securities. These calculated rates of return do not indicate the rates of return that must be allowed to these utilities to enable them to meet other necessary demands and charges against their net profits in addition to bond interest; nor do they include any of the necessary expenses incident to the issuance and sale of these securities, and do not indicate the rate of return that should properly be allowed to the owners of these utilities, as distinguished from its creditors, to compensate them for the obligation to repay to the creditors the money borrowed through the sale of these bonds and to compensate them for all of the other risks and hazards incident to the ownership and management of their enterprises.

This list embraces fifty issues authorized by the railroad commission during the first twenty-one months of its existence, a period of varying degrees of stress and ease in the money market. The prices at which these issues were authorized to be sold by the railroad commission represent the experience and best opinion of the responsible executives of twenty-nine well established public service corporations of the state of California. These prices were authorized by the Railroad Commission of California, after full hearing on each application, and may be assumed to represent its best judgment and opinion also. The fifty bond issues have a total par value of $48,086,-035; of this total $10,892,000, or 23 per cent, representing the very best of these issues, unusually well secured and having exceptionally large margins of earnings, were authorized to be sold at prices netting the purchasers from 5.34 per cent to 5.92 per cent per annum; $26,955,500, or 56 per cent, were authorized to be sold to net the purchasers from 6 per cent to 6.96 per cent per annum and $10,238,535, or 21 per cent, were authorized to be sold to net the purchasers from 7 per cent to 10.75 per cent per annum. These are the bare interest rates on secured obligations and do not include any percentage of profit in excess thereof which must be earned to make the bonds salable and do not allow for any compensation whatsoever to the stockholders who assume all the risks of operating these utilities and, under the California law, must guarantee the payment of the principal and interest of these secured obligations.

Necessity for Other Than Borrowed Capital.

Public utilities generally cannot conduct their enterprises entirely on borrowed capital, that is, on money raised through the sale of bonds. Money obtained through the issuance and sale of bonds secured by mortgage is the cheapest form of capital obtainable by utilities, as it involves the minimum of risk to the investor. The investor, however, naturally insists that the property pledged for his security shall exceed in value the face amount of the bonds issued against such security. This is not only a well recognized and generally observed principle in corporate financing but is a principle of ordinary business prudence which other lenders of money adopt in safeguarding their principal and which is also recognized by the laws of the state of California which prohibit savings banks from loaning money on real estate in excess of 60 per cent of its market value. In recognition of this principle it is customary to insert in mortgages securing issues of public utility bonds covenants limiting the par value of bonds that may be issued for purposes of aiding the utility in the payment of the cost of additions, betterments and improvements to amounts substantially less than the actual cost of such additions, betterments and improvements.

The railroad commission has not only repeatedly endorsed the principle and expressed the opinion that the utilities of California should not obtain all their capital from borrowed money, but has stated that not more than 75 per cent of the capital of the utilities of this state ought to be obtained by borrowing it. It follows that, irrespective of the conditions imposed under the terms of public utility mortgages, the utilities of this state must reckon on obtaining a substantial proportion of their new capital either from their earnings or from the sale of stock or other unsecured obligations which do not guarantee a fixed and certain return to the investor and must, therefore, be sold upon terms which compel the utility to pay a substantially higher rate than money may be obtained for through the sale of secured bonds.

Earnings and the Sale of Stock.

Notwithstanding the higher rate of return to the investor which an electric company may be willing to pay, or may be compelled to pay, for the purpose of raising capital through the issuance and sale of stock, this means of raising capital funds is practicable only in the event that it is able to earn and that it be permitted to earn, sufficient net profits from its operations to pay its bond interest, a reasonable dividend upon its stocks and a sufficient margin over and above such interest and dividend requirements as will create in the mind of the investor a confidence that the return upon his investment is reasonably well secured and is sufficient to compensate him for the risk he takes in putting his money into unsecured obligations with no definite fixed or obligatory rate of return and of assuming the responsibility for his proportionate share of such indebtedness as the company may incur during the period that he is a stockholder.

The rate of return to the purchasers of stocks does not indicate the rate of return that must be

allowed to utilities to enable them to earn the dividend rates shown and a sufficient margin of profit over and above such dividend rates to establish their credit and consequent ability to dispose of these securities. These dividend rates do not indicate the rate of return that must be allowed to these utilities to enable them to meet other necessary demands and charges against their net profits in addition to interest and dividends. These dividend rates do not include any of the necessary expenses incident to the issuance and sale of these securities.

Importance of an Established Confidence.

The ability of a well established utility to raise new capital for extensions, additions, improvements and betterments through the sale of its securities, and the prices which it may obtain for such securities depends entirely upon a confidence in the minds of the investors of certainty of return on such securities. This confidence in the certainty of return depends upon the net profits which the enterprise may be able or which it may be allowed to earn. If a public utility is unable to show a rate of growth in its net profits commensurate with the additional capital invested in its properties from year to year, or if its net profits decline or remain stationary, its ability to raise new capital becomes impaired, and if the necessary capital can be secured at all, it is only through the payment of very high rates of interest. If a public utility is able to show net profits, or is permitted to earn net profits, which are barely sufficient to pay bond interest its bonds thereupon become speculative securities and if they can be sold at all by the utility, can be sold only at a great sacrifice in price and the payment of a correspondingly high rate for the new capital. The ability of an established utility to market its securities at all, or to market them upon reasonable terms, depends largely upon the net profits remaining after providing for the payment of the interest or dividends upon such securities and this margin of safety determines in the minds of investors whether any given security affords a safe medium for the investment of their funds. The foregoing principles are so well recognized by both investors and bankers that it has become to be recognized as sound practice to insert in the mortgages securing public utility bond issues provisions that make the amount of bonds that may be issued dependent upon the net profits of the utility and assure, as far as it is possible, a certain fixed relation between the amount of the interest charges of the utility and the amount of net earnings available from its operations for the payment of such interest.

The Southern California Gas Company, a well established public utility operating in the southern part of the state of California, if it desires to raise new capital through the sale of any of its first mortgage 6 per cent bonds, must, under the terms of this mortgage, show that its net profits during a given period available for bond interest have been at least one and one-half times the amount of the interest on all the outstanding bonds and upon such additional bonds as it may desire to issue under the same mortgage.

There is active competition in the sale of investment securities to private investors, savings and other banks, life and fire insurance companies and other investment institutions and investors are constantly and actively importuned through circulars sent through the mails, through public advertisements, by letters and through the personal solicitation of traveling representatives of investment bankers. The November, 1913, issue of "Standard Bond Offerings," published by Standard Statistics Bureau, New York City, "a cumulative record of the bond offerings and wants of over 160 reputable bond houses in the United States and Canada for the previous twelve months" listed more than 4600 separate and distinct issues of investment bonds. Bonds of any company must be offered to investors in competition with these thousands of other investment securities and unless its bonds and stocks are protected by a substantial margin of earnings in excess of bond interest and dividends and in other respects conform to the standards of safety established in the investment world and in their quality are equal to or better than other securities, investors, who are free agents in the disposition of their capital, will simply turn to other securities which do have an ample margin of safety, are protected by sinking funds, earnings provisions and equity clauses in the mortgages securing the bonds offered to them and contain such other features as are necessary to inspire their confidence .

This list of bond offerings does not indicate the full extent of the opportunities offered for the profitable investment of capital in large amounts. Vast sums of money, which might otherwise be available to the gas and electric companies of this state, are being devoted to the construction of street railways and interurban railways, to the subdivision, developing and marketing of large tracts of land, to the development of mines and to the production, refining and marketing of oil. The demand for capital for these and other enterprises is particularly large and insistent in the state of California and this condition has an adverse influence on the ability of gas and electric companies to secure new capital and also tends to increase to them the cost of such new capital as they may succeed in attracting to their business. The capital available for investment purposes in the city and county of San Francisco and in the state of California is not sufficient for the development of its natural resources; the upbuilding of its public utilities and to meet the demands of the state and of the cities, counties and other political subdivisions thereof for public improvements and, for this reason, public service corporations are compelled to seek most of the new capital needed by them in the eastern states and countries of Europe far removed from the location of their properties. This condition contributes substantially to the difficulties of securing new capital and enhances the cost thereof.

Permanency of Utility Enterprises.

The property of a gas and electric enterprise is irretrievably placed in the service of the public and its owners cannot, at their will, wind up the affairs of the corporation and liquidate and distribute its assets. The financial, engineering, operating and commercial management of such gas and electric enterprises is constantly beset with hazards and difficulties arising

from financial stringencies, from the competition of other forms of energy, from the actual and potential competition of other like utilities, from the actual and potential competition of municipally owned utilities, and from the diminution of revenues through the improvement of lamps and other current consuming devices, from the constantly growing burden of taxation, from the constantly increasing cost of labor and continual demands of organized labor for higher wages, from the changes in processes of manufacture and improvements in the mechanisms employed in the manufacture and distribution of their products with which they must equip themselves and for which the necessary capital must be found, from the regulation of rates which, in the final analysis, are determined by the interested rate payers, from the uncertainties arising out of rate regulation once every year, from the destruction of property by the elements, and from the liability for compensation to thousands of employes engaged in hazardous occupations. Whatever may be the result of these conditions the utility must remain and suffer the consequences.

An Appeal for a Greater Rate of Return.

According to the 1913 report of the comptroller of the currency, the 504 national banks contained in the Pacific states for the year ended June, 1913, paid dividends amounting to $10,381,416, 11.94 per cent of the capital of these banks. The net earnings to capital and surplus of all of the national banks in the United States were 9.06 per cent during the same year and during the 44 years from 1869 to 1913, the percentages of earnings to capital and surplus of these banks averaged 8.65 per cent. If, under government regulation, capital may be employed in the business of banking, with the confident expectation of such profits as these, gas and electric enterprises of the state of California, to say the least, should not be limited to any smaller rate of return.

GENERAL ELECTRIC ANNUAL REPORT.

The annual report of the General Electric Company for 1913 shows that the business done during the year in the value of the orders received exceeded in volume the record of any previous year. These orders were valued at $111,819,000, and the amount of sales billed was $106,477,000, the net profit from sales and income from other sources $14,065,789. There was paid in interest charges and charged to discount on debentures and notes the sum of $1,007,910 and $8,149,204 in dividends, leaving $4,908,674 to be carried to surplus account. The increased number of orders and expenses of filing them, together with increased competition, caused an unavoidable addition to the expense account. The number of employes on December 31 was 65,000. The patent account is carried at $1, although nearly $663,000 was spent for patents and expenses of the same during the year. Stocks and bonds have a valuation of $25,964,000, of which $17,574,843 represents stocks of subsidiaries and $8,389,473 in stocks and bonds of public utility and other companies. Subsidiaries have had liberal advances during the year to provide increased working capital, and the total amount due from the companies is $6,817,563, making the aggregate balances of all accounts and notes receivable $33,028,000. In July last year nine months' notes for $8,000,000 were sold, but money was deposited out of current funds to meet them. Chairman Coffin says the company has no other paper outstanding, notwithstanding the strain of last year's unsettlement. The report should be considered in every way satisfactory by shareholders, as the company came through troublous 1913 with flying colors and faces the future with confidence.

MINERAL INDUSTRY IN CALIFORNIA.

In the early years of its existence California was a mining State, pure and simple. To-day the mineral industry receives little attention from the public at large, yet it is greater and more extensive than in the palmiest "early days." Gold was discovered in 1848. The output for the following year amounted to $10,151,360. In 1852 it had grown to a total of $81,249,700. With the years succeeding this maximum production the mines of the State continued to yield fabulous wealth, but in decreasing amounts, until their fame became gradually dimmed. The low water mark of the industry was reached in 1889, when the total mineral output equaled $16,681,731, over $11,000,000 of which was gold. That year also marked the beginning of the present era of practical and scientific development of the varied mineral resources of the State. Improvement in methods of development, treatment and management has increased the annual gold production to about $20,000,000—a figure which has approximately held for the past ten years.

The discovery and development of oil-bearing territory has been the largest single factor in the recent growth of the mineral industry, although the building up of the cement industry, and the exploitation of deposits of the widely varying structural and industrial materials which are now commercially produced, have all helped materially in causing it to reach its present gigantic proportions.

The following interesting data are presented by State Mineralogist Hamilton, graphically illustrating the regeneration of the mineral industry in California since 1889. The estimated figures for 1913 are based on partial returns from individual producers in the State and are conservative in every case:

Value of Annual Mineral Output for Various Years, 1889-1913.

1889	$16,681,731	1908	$66,363,198
1894	20,203,294	1909	82,972,209
1899	29,313,460	1910	88,419,079
1904	43,778,348	1911	89,747,879
1906	46,776,085	1912	91,472,385
1907	55,679,949	1913 (Estimated)	100,000,000

Mineral Output for 1905 and 1912, With Comparative Estimates for 1913.

Substance.	1905.	1912.	1913.
Petroleum	$ 9,007,820	$41,868,344	$ 46,000,000
Gold	19,197,043	19,713,478	20,000,000
Cement	1,791,916	6,074,661	8,000,000
Copper	2,650,605	5,638,049	5,500,000
Crushed rock and granite	2,070,607	5,473,928	6,000,000
Brick	2,273,786	2,940,290	3,000,000
Borax	1,019,158	1,122,713	1,250,000
Natural gas	102,479	940,076	1,250,000
Silver	678,494	799,584	800,000
Quicksilver	886,081	866,024	700,000
Other minerals, including asphalt, clay, lead, marble, mineral earths, salt, tungsten, zinc, etc.	3,391,238	6,035,238	7,500,000
Totals	$43,069,227	$91,472,385	$100,000,000

UNDERGROUND ELECTRIC MINE HAULAGE

PROPER VOLTAGE FOR UNDERGROUND TROLLEYS.

BY G. L. PERRIN.

(This article was presented as one of the papers before the recent section meeting of the Nevada Industrial Safety Conference, and should be read in conjunction with those other papers on this subject published in a recent issue of this journal.—The Editors.)

An unprotected bare wire is more or less dangerous regardless of potential, if proper precautions are not observed with regard to distance from rails and location as to chutes and switching stations. If trolley wires were kept at least 7 ft. above rails and protected near chutes and switching stations, and steel, and so forth, were not allowed to be carried through

FIG. 1.

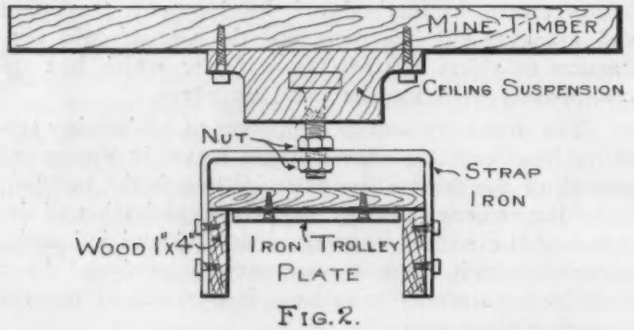


FIG. 2.

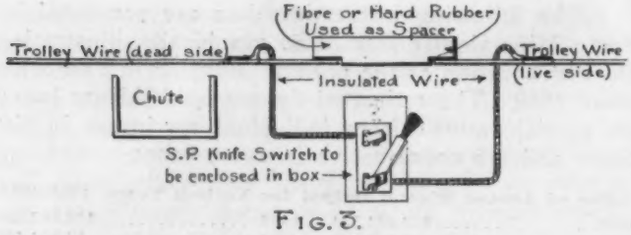

Fibre or Hard Rubber Used as Spacer
Trolley Wire (dead side)
Trolley Wire (live side)
Insulated Wire
Chute
S.P. Knife Switch to be enclosed in box

FIG. 3.

Details of Trolley Protection Troughing.

the drift or tunnel, I do not think 110 volts could be classed as dangerous, but would recommend that voltages exceeding 440 be discouraged for underground work.

I do not know of any advantage, as far as safety is concerned, of a.c. over d.c., or vice versa, except that the d.c. single trolley has the advantage over a.c. three-phase, inasmuch as theer are fewer wires to watch.

Trolley wires can be protected by troughing. This can be best installed by substituting iron plates for wires, these to be bolted to a board 1 in. x 4 in. with sides of the same dimensions, also of wood. In dry places these troughs can be nailed to timbers, using the wood as insulation between line and ground. However this can only be approved in exceptionally dry places. (Fig. 1), while for damp places, the same troughing scheme can be employed, but insulated from timbers by bolting trough to an iron strap which is in turn bolted to an ordinary trolley ceiling suspension (Fig. 2.)

For further protection around chutes and switching stations, sectionalizing switches to cut off the current from the part of the trolley near which work is going on, seems to me to be almost a necessity regardless of what other means of protection are used. This latter scheme (Fig. 3) is employed by the Nevada Hills Mining Company and has proven very satisfactory.

While I am not aware of the single-phase type of locomotive being either manufactured or used extensively for mine service, I believe it to be the next step forward in underground mine haulage. In fact the variable speed, single-phase motors as manufactured by the General Electric and Wagner Companies, are well worth investigating by those considering the building of locomotives for mine service.

I have constructed two locomotives for use in hauling loaded cars from the ore chutes of the Nevada Hills Mining Company to the station. They are equipped with three-phase, 440 volt, induction motors, geared to the axle by a chain belt. The current is taken from two overhead trolleys, the rail representing the third leg. They have been economical in maintenance, but have caused injury from electric shock to the workmen in the mine.

Coal briquets to the amount of 181,859 short tons, valued at the plants at $1,007,327, were manufactured in 1913, according to Edward W. Parker, of the United States Geological Survey. The figures for 1913 show a decrease of 17 per cent in the tonnage of briquets manufactured, but an increase of over 5½ per cent in value over the figures for 1912. Seventeen briquetting plants were in operation during the year. Seven of these used anthracite culm or "fines," five used bituminous or semi-bituminous coal, two carbon residue from oil-gas works, and the others used mixed coals. Coal-tar pitch is the principal binder employed, eight plants using it. Patented binders were used at five plants. If the future of this infant relative of the coal mining industry is to be judged by the record of 1913, the judgment should be based on the increase in value rather than on the decrease in tonnage. An exception to this decrease is to be noted on the Pacific Coast, the production in 1913 was exactly double that of 1912, with a gain in value of somewhat larger proportion. Mr. Parker believes that the briquet as a domestic fuel is bound to increase in popular demand as its good qualities come into more general notice. The briquets which appear to meet with greatest favor in the Eastern states are of the boulet type, egg or pillow shaped and about the size of anthracite nut. The briquets that are practically smokeless, as they should be, make an ideal fuel for the open grate or kitchen range, holding their shape until entirely consumed and then falling, when stirred, into a pulverulent, clinkerless ash. In the Central and Pacific Coast states the popular type of briquetted fuel appears to be the larger size, about that of egg coal, for which the raw materials available seem to be best adapted.

ELECTRIC PUMPING AND IRRIGATION

PUMPING FOR IRRIGATION.

BY E. V. BERG.

(The author describes the various systems and economies of pumping for irrigation and describes, in closing, a particular central station pumping plant installation.—The Editors.)

Of late years irrigation by mechanical means has been steadily growing. This method of applying water to arid lands is destined to become still more widely used. Practically all lands easily susceptible of irrigation by gravity, namely, by diverting water from a stream into a grade canal, have now been put under ditch. Much of the land remaining in the arid states and fit for cultivation must be watered by the use of pumping machinery.

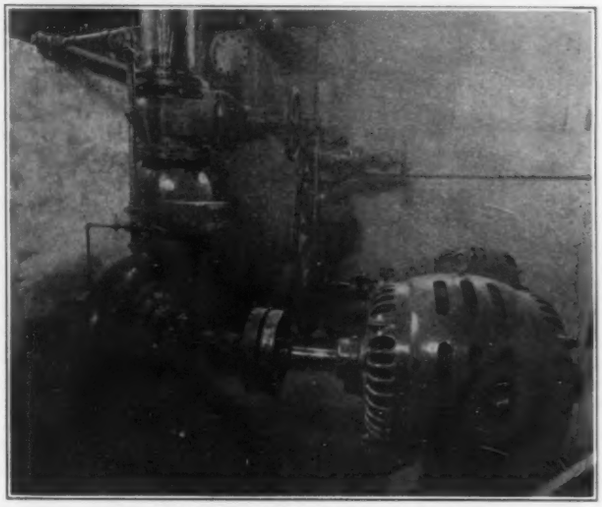
Several years ago a feeling of doubt existed as to the feasibility and reliability of using pumping machinery for irrigation purposes, the pumps, motors and engines had not reached their present high state of perfection; but any feeling of doubt as to the success attained by a modern plant is dispelled by observing the records of existing plants. The development of the centrifugal pump, for example, has been coincident

Central Pumping Plant Located on River-Bank.

with the growth and improvement in all lines of machinery, and people have come to recognize the centrifugal pump as a piece of apparatus having a distinctive field. It is one means by which thousands of acres of otherwise worthless land have been made to at once provide homes and produce exceptional crops.

Pumping for irrigation is practiced in a variety of ways and by a variety of methods. The water may be raised from a river to the high land above, it may be taken from a gravity canal and applied to higher lands, or it may be lifted from dug wells to the surface of the ground. The principles involved and power requirements, though the same in each case, varies. For example, when pumping from deep wells the vertical submerged centrifugal pump is used, or, in some cases, the air lift pump, while in the other two cases mentioned the horizontal type of centrifugal pump finds more general application. The centrifugal pump is driven by an electric motor, or one of the various kinds of engines, steam, gas or oil. In special cases and where conditions are favorable, hydraulic rams, air lift pumps and even windmills are used.

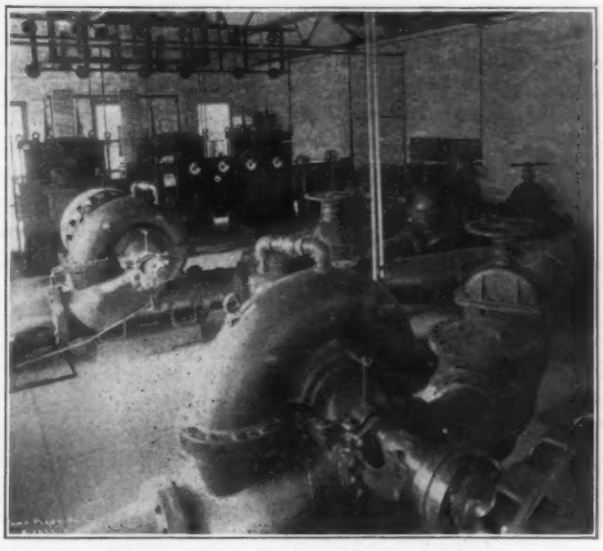
The particular way in which water is raised, owing to best adaptation of the land to be irrigated, often determines whether the isolated plant, the small plant supplying a small acreage, is to prevail, or whether it is to be the large central station, often supplying irrigation for thousands of acres to hundreds of land owners. Arguments may be presented for or against either system, as in the case of electric stations



An Individual Pumping Installation.

for power distribution, though in the case of pumping the small isolated plant is more advantageous than the isolated electric plant.

In California individual or isolated pumping plants predominate. The water is raised from wells having a limited capacity to be applied to a comparatively small acreage, and the land and water system then belongs to and is in the control of one man. In Idaho the case is different. Here the large or central station



Interior of a Central Pumping Plant.

plant predominates, since the water is taken from rivers or large canals having practically an unlimited supply. The system is run by an organization having proper officers, and each individual is simply a part of the company. While the larger pumping stations

are more economical of operation, from a mechanical standpoint, they are apt to be somewhat less economical than the small plant in the use of water. In the latter case, one person has control of both his land and water, and can run his farm as carefully and economically as possible.

The writer's irrigation experience is largely confined to the State of Idaho, and what follows is written

A Removable Flash-Board.

as a result of that particular experience. As is well known, Idaho has within its borders more large gravity projects, as well as pumping projects, than any other state in the Union. The people have availed themselves of the Carey Act as a means of land development to a greater extent, it is believed, than all the other states combined. In addition to this, the Reclamation Service has several large projects, both gravity and pumping; in fact, their pumping project on the Minidoka tract, covering nearly 50,000 acres, is one of the best equipped and most successful in the world. Another plan of building irrigation works is by the creation of irrigation districts in which all land owners combine and by bonding their property are able to raise money for construction. Under the Carey Act private individuals may make a contract with the state for the construction of works to irrigate certain lands. The work is done under the supervision of state authorities, and the construction company is then allowed to sell its water which was made available to the land at a price fixed by the State Land Board. Pumping systems, practically all of which have proven successful, have been constructed in this state under all these different methods.

In a state where gravity projects and pumping projects are often adjacent, comparisons are sometimes made of the relative merits of the two plans, of the cost of construction, operation and so forth. It is difficult to find a proper basis of comparison regarding construction, though it is this cost which generally determines whether a particular piece of land shall be watered by gravity or pumping. Usually the cost of a dam or reservoir and ditch lines, if possible at all, would be prohibitive where a pumping system would be entirely feasible and comparatively cheap. In comparing the operation of the two systems, not only should the actual physical operation of plant and canals be taken into consideration, but the kind and amount of crops, and, finally, the profit earned per acre under each system. Pumping systems require more careful management and supervision in the handling of water than is necessary under gravity flow, since in the former the cost of operation is in direct proportion to the amount of water used, while this is not the case under gravity.

It is for this reason that pumping projects are not always immediately successful from an operating viewpoint. When there are a number of farmers on a tract raising diversified crops, needing water in different amounts and at different times, and not making any special effort toward co-operation, the system cannot be operated as economically as when all interested are alive to the fact that there must be co-operation and that the best farming methods must prevail. The ideal condition would be where the management of the land and water was in one person or organization. Then the most profitable crops only would be farmed, the water would be economically used, and machinery would be applied to do all farm work on the largest scale. Thus we see that on a large project containing many individuals, it is the human element that makes for success or failure of the project as a whole. However, it is the belief of the writer that the incentive to economy required by a somewhat higher maintenance and operation charge will lead the land owner to a more careful study of crops, to apply better farming methods and to co-operate with his neighbors for the general good. It seems that these things must lead to greater production, acre for acre, of the crops that pay, over those produced under the average gravity system, and this, together with the prevention of injury to the land itself, which, through careless handling, so often occurs under gravity systems, will much more than counterbalance any added expense in the physical operation of one system over the other.

There are two fixed items in the planning of a height of lift and cost of power. In determining the cost per acre foot or other water unit. These are heights of lift and cost of power. In determining the

Drop With Baffle Wall.

proper height of lift, it is necessary to have a topography map of the land to be irrigated, from which the number of lifts which will keep the average elevation at a minimum, may be found. A practical minimum is meant, as it would not pay to divide the total height into too many parts, thus entailing too great a construction cost, without a corresponding saving in operation. The limit of height to which water may be

profitably pumped depends upon the kind of crops raised. It is believed that with the prevailing price for power that an average lift of 60 ft. for grain and hay crops is about the upper limit in this state. For potatoes, peas, beans and vegetables of this class, the height might be raised to 100 ft., while for a still higher class of product, such as fruit and clover, flower and vegetable seeds, a lift of 200 ft. is practicable.

In the matter of power or the kind of prime mover employed to drive the pumps, location of the land to be irrigated is one of the determining factors. In a region where oil fuel is cheap, oil, gasoline or steam engines are used to a large extent, but in parts of the country where oil is expensive, and water power plentiful, as in this state, practically all pumping is done by means of electricity. The electric motor is an ideal drive for centrifugal pumps, and is so much superior to every other method that wherever possible it is given the preference. The cost of electric power for irrigation depends on whether its generation is part of the general irrigation scheme or whether it is bought from a separate power company. In the former case, the cost is net, or as much as it costs to generate the power, while in the other case contracts are made for a certain sum per horsepower per irrigation season. The price depends on whether the service is 20 or 24 hr. per day. The prevailing 24 hr. per day per season rate is $18 per h.p., based on maximum demand. In some cases a meter rate is made in addition to a certain fixed monthly charge. Both rates have advantages, though the latter method gives a little more incentive toward economy on part of water user.

An incidental advantage of great importance in connection with the electric pumping systems is the distribution of electric power for farm purposes. The service wires are run from the pump substation throughout the tract, and power and light are made available to all who desire it. Power conveniences are a great help toward keeping up a general tone of satisfaction among the farmers, and tend toward a more neighborly feeling.

The writer is connected with a project called the High Line Pumping Project, containing about 3700 acres, on which the average lift is 45 ft. The installation is typical of the pumping plants built in this state, and a general description might be of interest.

The land in the project is under two lifts, 3000 acres under a 40 ft. lift and 700 acres under a 68 ft. lift. A careful contour survey fixed these lifts as being at the most economical elevations. Three 15 in. centrifugal pumps were installed, each having a capacity of 13 sec. ft., or about 1 acre ft. per hr. On this basis the three pumps would cover the 3000 acres supplied by them to a depth of about 3 ft. during the irrigation season of four months. This is more than sufficient, and it is believed that two pumps will throw enough water for all purposes, which leaves the third machine as an emergency unit. These pumps are of the double suction, split case type, made by the American Well Works Company of Aurora, Ill., and are direct connected through flexible couplings, to 100 h.p. induction motors. The motors are Form L General Electric, having internal starting resistance. There are 700 acres under the 68 ft. lift, and are served by two 8 in. pumps, connected to 50 h.p. motors, both pumps and motors being of same type as the larger machines above mentioned. Wood pipes are used to convey the water from the pumps to the canals, the three 15 in. discharge pipes combining in a 32 in. pipe, and the two 8 in. pumps discharging into a 22 in. pipe. There are no reservoirs on this system, but water is pumped directly into concrete basins from which, canals take out in opposite directions. Both motors and pumps are thoroughly protected by safety devices, each motor having a separate switchboard panel containing no-voltage and overload release, and the pumps being provided with both check and gate valves in the discharge.

Exterior View of Central Pumping Plant.

The substation adjoining the pumping plant contains two banks of transformers, each having a capacity of 225 kw., together with choke coils, electrolytic lightning arresters and automatic switching devices. The current enters at 22,000 volts, and is transformed down to 2200 volts, which is the operating voltage of the motors.

This system has been in successful operation for three years, and with the small apparent wear and tear thus far, would indicate that a depreciation of 2 or 2½ per cent would be ample when figuring the life of the plant.

That municipal gas plants do not succeed in selling as large average quantities of gas per consumer as do private companies was the gist of a paper on "Municipal Gas Undertakings and the Consumer," presented by Robert Watson of Doncaster at a recent meeting of the Manchester District Conference of British Commercial Gas Association. Substantive statistics were given. The development of municipal plants is greatly hampered, he said, by opposition to anything that might be classed as municipal trading, whereas there is no such interference with the progress of private companies. In the face of such obstacles municipal authorities cannot do their best to stimulate gas consumption, and in the long run plumbers, gasfitters and hardware dealers suffer from the restricted use of gas. During the discussion which followed, this opposition was also commented on by other speakers.

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CONTENTS

Electric Distribution 419
By Richard C. Powell.

A New Method of Destroying Teredos 423

Capitalization of Water Rights 424

Gas Has Influenced London Fog Conditions 424

Cost of Financing Utilities 425

General Electric Annual Report 429

Mineral Industry in California 429

Proper Voltage for Underground Trolleys 430
By G. L. Perrin.

Coal Briquets 430

Pumping for Irrigation 431
By E. V. Berg.

That Municipal Gas Plants Do Not Succeed 433

Editorial 435
Capitalization of Water Rights.
Co-operation in Opposition.
The Age Practical.

Personals 437

Obituary 438

Meeting Notices 438

News of the California Railroad Commission 439

Examination for Electrical Engineer and Draftsman 439

Trade Notes 439

New Catalogues 439

News Notes 440

Capitalization of Water Rights

It is left to the highest courts to interpret the spirit of the law—the highest sense of justice. In a recent decision, printed in this issue, the Supreme Court of the United States emphasizes the importance of the principle, that there can be no justice in equality where enterprise is not equally advantaged. This is one expression of the spirit of the law.

It used to be contended that water must be the property of all, just as is light, and the air we breathe, for water is essential to life. But its equal distribution or its withdrawal from improved or exclusive use of surplus, is something which can only be invoked when equal distribution is essential because of waste or the then non-existence of that surplus.

In the interim, improvements are beneficial to all. But all cannot and will not make such improvements, though all have equal opportunity to do so. Is it not just, therefore, that the individual—prospector, speculator, or pioneer, as you will—who makes the improvements should be the one most to benefit? And not only by earnings upon the capital invested but because of improvement in the water right—the unused and neglected property and possibilities of the people.

A water right unimproved is waste, and it is present waste which is responsible for the high cost of living and the still higher cost which is the promise of the future.

Whatever will eliminate this or tend to do so, should be proportionately rewarded and it is not altogether surprising to find that the highest court of the land in its highest interpretation of the law, finds that capitalization of water rights, in estimating plant valuation for rate-making purposes, should be allowed.

No court has questioned the capitalization of water rights except for irrigation. The question has been raised by railroad commissions in the case of hydroelectric power companies and consequently this decision is of wide interest.

This particular decision deals with these rights in connection with the sale of water for irrigation purposes but the contention of the court, that by such sale all do not benefit directly, but a part of the people only, and for their private benefit, makes this ruling applicable to all utilities utilizing water rights—hydroelectric companies with others.

It was argued, that under California law, should the holder of a water right appropriate the water to distribution and sale, he thereby dedicates it to public use and loses its private right in it.

The court contended that such an appropriation and use does entitle those within reach of the water to demand a reasonable share upon due payment but pointed out that the holder, or water company, has the sole right to furnish this water which could not be secured by the owners of irrigable lands, but

through the company. That fact must be taken into consideration in determining rates.

As further pointed out, it seems unreasonable to suppose that the declaration in the Constitution of 1879, that water appropriated for sale is appropriated to a public use was intended to compel a gift from the former owner to the users or that if in dealing with waters "appropriated for sale" it meant that there was actually nothing to sell.

This decision does not state specifically that all water rights may be capitalized, those appropriated as well as those acquired for a valuable consideration, but it practically establishes the principle that not to permit capitalization of water rights is to deprive the owner of them without due process of law, which is an infringement of constitutional rights.

The manner of arriving at this valuation is a different matter, and while many methods have been suggested, that which will be most equitable will be one which is based upon the measure of the complete utilization of the water right and its most beneficial use.

Co-operation in Opposition

"Like adversity, adverse decisions make strange bedfellows," comment the newspapers in effect, for arrayed in an appeal for rehearing of the now important Oro Electric case are both the California Railroad Commission and representative corporations—the controller and the controlled.

And this comment would not be called forth but for the fact that it is only a seeming strangeness.

The legal, is a wordy warfare in which power goes to the victor because of right; law, as shown in a recent editorial, being but a reasoning up to the right.

These two powers—the corporation and the commission—though opposed, are actually operating together in the interests of that section of the public they both serve, thus exemplifying co-operation in opposition.

It is inadvisable to endeavor to secure your rights under and within the law, whenever those rights inflict a wrong upon those to whom you are in opposition.

The law of reasoned right is for all, and for the public service commission which will ignore precedent and in the best interests of all involved will judge of things as they are, there can be but the highest commendation and praise.

It is an economic principle, that where regulation of public utilities, whether state or municipal, obtains then competition must be restricted. The principle of regulation may be involved only where monopoly prevails. If you must have regulated competition, regulate it, but not the sale price of the product, or, rates.

Let them so soar, as they must of necessity, that a disgruntled public will eventually desire a return to monopolistic service.

It is very elementary that duplication of distribution systems increases the cost to the consumer; is inefficient and wasteful. It is not effective in reducing rates because it adds nothing to the service, than may be added through regulation, but cost.

The purblind selfishness of any public utility which would insist upon competition with rate regulation can not but create suspicion and react upon private owenrship in general.

And the question arises, should there be one law for rural districts and for those who, perhaps in wisdom, delegate the regulation of their utility affairs to the commission, and another for those who do not?

If this journal were opposed to the regulation of utilities by municipalities it would be on the grounds that the public themselves, as a municipality, may at any time become the competitors of the utility they regulate, in which event, except at great legal expense (also borne in duplicate by that same public) there would be no power to regulate the regulator.

Moreover regulation of public utilities is a matter of extremely expert knowledge and ability combined with the power to rise to the occasion. It is not something which may be undertaken by every Tom, Dick or Harry merely because authorized by the people on their behalf.

If this fact were fully appreciated such absurd situations would never occur as recently arose in one city where a utility, by the figures of the municipality's own public service experts, is to be allowed an estimated rate of return upon its investment of but 3½ per cent.

In municipal regulation there is a constantly recurring possibility of injustice which it would be well to anticipate by extending the power of state commissions so that they will be enabled to regulate all the public utility business, municipal or otherwise.

This situation, promising one law for all people and its uniform interpretation, is worthy legislative consideration and the enactment of whatever is necessary in order to extend the powers of public service commissions to that end, for there is no opposition between the public, through its accredited commission and the utilities it controls, but a friendly fight for the establishment of what is right.

The Age Practical

You live in the age practical. Your theory must be demonstrated to prove its utility. Then the world will supply an attentive audience. The realization of our ideas of the practical constitute the difference between the civilizations past and that of today. Unless you are prepared to prove your ideas practical none will listen though the possibilities they contain are vast. "Show me!" leaps to the lips to preclude doubt and doubt lingers until your demonstration of utility is complete.

In an endeavor to achieve the intensely practical is questioned that which has been done before. Today we investigate that the performance of the morrow may be more complete. It is a search after Truth. As soon as you question you open up the avenues of advancement which your performance then makes possible.

But questioning without honest investigation is complaint; investigation without understanding but increased ignorance; understanding without action causes atrophy and a too early death.

We must investigate, understand and act.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Frank J. Somers of the Century Electric Company, San Jose, Cal., is at San Francisco.

F. H. Cable has been appointed test engineer of the Pacific Light & Power Corporation, Los Angeles.

Frank Cavenagh, Pacific Coast manager, Metric Metal Works of American Meter Company, is at Los Angeles.

C. V. Schneider, president Electric Supply Company, Sacramento, was at San Francisco recently on business.

H. H. Howell of the Howell Electric Company, San Diego, Cal., was at San Francisco on business during the past week.

W. L. Goodwin, vice-president Pacific States Electric Company, San Francisco, has returned from Southern California.

M. Wm. Hild, of the Electric & Machine Equipment Company, Stockton, Cal., was a San Francisco visitor during the past week.

M. A. Stamfer will build that part of the new line of the Nevada-California Power Company into Imperial Valley, between Banning and El Centro.

O. B. Coldwell, general superintendent of the Portland Railway, Light & Power Company, has returned to Portland after a week's visit in California.

S. B. Gregory, Pacific Coast manager, Arrow Electric Company, has returned to San Francisco, having made a business trip through the northwest.

W. R. Pounder, Pacific Coast representative Hubbard & Company, has returned to San Francisco from a business trip made through the northwest and Montana.

W. de P. Tardiff has severed his connection with the Holabird-Reynolds Company and is now city salesman with the Electric Appliance Company, San Francisco.

H. F. Holland, representative of the Simplex Electric Heating Company, left Salt Lake City this week for a month's trip to Los Angeles and other Pacific Coast cities.

A. E. Barlow, Pacific Coast sales manager, and **J. W. Leighton,** of the American Eveready Works of National Carbon Company, were visitors at Seattle last week.

F. H. Poss, Pacific Coast manager Benjamin Electric & Manufacturing Company, San Francisco, is on a vacation trip through Lake and other counties north of the bay.

D. A. Taylor, secretary and treasurer H. Northwood & Company, Wheeling, West Virginia, manufacturers of "Luna" and other lighting glassware, was at San Francisco last week.

E. M. Herr, president of the Westinghouse Electric & Manufacturing Company, left last week for the East via Portland and Seattle, having spent several weeks visiting California cities.

E. E. Gray of the Hotpoint Electric Heating Company, has spent the last week at Salt Lake City making preparations for the celebration of "Hotpoint Week" by the various electrical interests.

C. B. Hall of the Illinois Electric Company, at Los Angeles, and **R. D. Holabird** of the Holabird-Reynolds Electric Company at San Francisco, are attending the jobbers convention at Atlanta, Ga.

Mortimer Freund, associated with Percival R. Moses, consulting engineer, has been superintending the electrical and mechanical installations in the new Hudson Bay Company's store at Vancouver, B. C.

A. V. Olson, formerly associated with the Pacific Coast office of Pass & Seymour, is now with the Electric Railway & Manufacturers' Supply Company at San Francisco.

G. C. Pierce, vice-president and general manager, Santa Monica Water Company and Sawtelle Water Company and of the Santa Monica Mountain Park, Santa Monica, Cal., stopped off at San Francisco during the past week. en route to New York.

Melcher Ekstromer, electric vehicle specialist with the Electric Vehicle Company, is at Salt Lake City from Denver in connection with some large deals on electric trucks under consideration there by two of the large department stores.

C. E. Hearn, the popular specialty salesman of the Electric Appliance Company, has left on his initial trip as territory representative in Southern California and Arizona. **Grover Anderson** will occupy Mr. Hearn's place at the San Francisco office of the company.

S. R. Inch, general superintendent; **W. R. Putnam,** new business manager, both of the Utah Power & Light Company, and **C. A. Cohn,** superintendent of power stations of the Utah Light & Railway Company, will attend the convention of the National Electric Light Association at Philadelphia early in June.

Arthur Walser, district manager of the motor department of the General Electric Company's Denver office, has not transferred his headquarters to Salt Lake, as was recently stated in these columns by error, but will continue to work from Denver, having recently returned there from Salt Lake City.

W. R. Steudemund, Pacific Coast manager, Gillinder & Sons, Philadelphia, Pa., is leaving San Francisco for a trip through the Pacific Northwest and British Columbia. Mr. Steudenmund will go East on his annual trip to the company's head office and works, returning to San Francisco the latter part of July.

P. B. Sawyer, vice-president and general manager of the Utah Power & Light Company, has returned from a three weeks' trip through the East. While away he attended a meeting of financiers interested in power projects in the West, **D. C. Jackling,** president of the Utah Power & Light Company, being among those present.

A. G. Pratt, assistant to president, Babcock & Wilcox Company, manufacturers of water tube boilers, is making a tour of the Pacific Coast. He will be accompanied by **Elgin Stoddard,** vice-president and general manager of Chas. C. Moore & Company, Engineers, who represent Babcock & Wilcox on the Pacific Coast.

George Kidd has been appointed general manager of the B. C. Electric Railway Company, Ltd., at Vancouver, B. C., to succeed **R. H. Sperling,** who has been appointed assistant to the chairman of the board of directors with a seat as director. In making the new appointment the board expressed its sincere thanks to **F. R. Glover,** general executive assistant; **C. R. G. Conway,** chief engineer, and to all other officers of the company for their services and loyalty during Mr. Sperling's administration.

Carlton R. Rose, for a number of years superintendent of the United States Zinc Company, Pueblo, Colorado, subsidiary to the American Smelting & Refining Company, has recently resigned his position and become an associate of Smith, Emery & Company, inspecting, testing and chemical engineers and chemists. Mr. Rose will be located at San Francisco and will take an active interest in the business. His strong and pleasing personality and varied experience in university work and practical accomplishment will add materially to the strength and range of the firm.

John P. Mallet, member A. I. E. E., has been appointed by the Society for Electrical Development, Inc., to investigate present and possible power applications. The information thus gathered will be turned over to the Commercial Exchange Bureau which has been inaugurated in charge of **Theodore Dwight** for some years assistant secretary, American Institute of Mining Engineers. Other appointments of the Society and recently made are: **James Smieton Jr.,** office manager and secretary-treasurer; **H. C. Spaulding,** in charge of news and advertising department, with **Harry Chapin Plummer** as assistant.

Otto B. Goldman, contracting engineer, Portland, Ore., has been elected an associate member American Institute Electrical Engineers. Other western associates elected at the

April meeting were: **Walter C. Clark,** superintendent Light & Water Systems, Kellogg, Idaho; **Herbert J. Gray,** sales agent Canadian General Electric Company, Vancouver, B. C.; **Bernhard Olsen,** motor agent, General Electric Company, Spokane, Wash; **J. H. Paget,** meter engineer, B. C. Electric Railway Company, Ltd., Vancouver, B. C.; **Foster Russell,** commercial engineer, Washington Water Power Company, Spokane, Wash., and **Wm. K. Stacy,** assistant to electrical engineer, Washington Water Power Company, Spokane, Wash.

Allen C. Morse, who for many years has been engaged in engineering work, has been chosen as resident engineer and manager of the new office of the firm of McMeen and Miller, at 407 Electric Building, Cleveland, Ohio. which will co-operate with the Chicago office of the firm in the general conduct of its business. At its Cleveland office, McMeen and Miller will continue to serve, not only public service corporations, municipalities and commissions as may be required, but will devote particular attention to the rehabilitation of plants, the making of appraisals, the establishment of proper systems of records, and to any other work in which they may properly serve the interests of their clients.

OBITUARY.

J. C. H. Stut, well-known as a designing mechanical engineer, died at Oakland, Cal., on May 7, 1914, aged 63 years. Mr. Stut was born in Germany and started as a blacksmith's helper at San Francisco in the early seventies. His studious application was gradually instrumental in his rising to the top of the profession. From 1878 to 1886 he was draughtsman with the Union Iron Works. In 1887 he designed and promoted the cable railway on Howard and Ellis streets in San Francisco and in later years was closely associated with the development of the cable roads in that city. The great Dutch windmill in Golden Gate Park was designed by him and stands as a monument to his ability. At the time of his death he was consulting engineer for several corporations, including the Union Sugar Company. His death marks the passing of one of the few who remain of the "old guard."

MEETING NOTICES.

Portland Sections A. I. E. E. and N. E. L. A.

A joint meeting was held on Tuesday, May 5th at 8 p. m., at the Assembly Hall, Hawthorne Bldg., Portland, Oregon, when an illustrated lecture on some of the Economic Problems of a Public Utility was presented by F. W. Hild, manager, Portland Railway, Light & Power Company.

Oregon Society of Engineers.

Ralph Modjeski gave an illustrated talk on The New Quebec Bridge in Room A of the Public Library, Portland, Oregon, on Monday evening, May 4th, at 8 o'clock. Mr. Modjeski is a member of the Quebec Bridge Commission, and this was an excellent opportunity for the members to get information regarding this immense structure at first hand. There was a good attendance.

Pacific Northwest Society of Engineers.

The twelfth annual convention of the Pacific Northwest Society of Engineers will be held at Seattle, June 19 and 20, 1914. The session of the first morning will include reports and technical papers. The afternoon session will probably be occupied with a visit of inspection to the Lake Washington canal locks. In the evening a banquet will be served and Chas. H. Swigart, supervising engineer, Washington division, United States Reclamation Service, North Yakima, will present a paper on the storage problems of Yakima valley. Saturday will be wholly taken up by an excursion over the Milwaukee railroad to the storage dam of the United States Reclamation Service at Lake Keechelus. Joseph Jacobs, Central building, Seattle, is president of the society, and Jesse A. Jackson, Municipal building, Seattle, secretary.

Oregon Electrical Contractors' Association.

The following program has been arranged in connection with the convention of this association to be held at the Moose hall, Portland, Oregon, on June 8 and 9, 1914:

Morning: 9:30—Address of Welcome, J. E. Werlein; Response, President R. G. Littler; Paper, The National Electrical Contractors' Association, Ernest Freeman, national president; The Electrical Jobber, Ross Hartley; The Society for Electrical Development, J. M. Wakeman, manager; Stereopticon Address, Fire Causes and Prevention Suggestions, E. M. Underwood.

Afternoon—Business meeting, members only; 3:00, trolley ride to Council Crest; 7:00, trolley ride to The Oaks.

Tuesday, June 9th: Morning, 9:30—Inspection of local power plants of Northwestern Electric Company and Portland Railway, Light & Power Company.

Afternoon, 2:45—Attend Pacific Coast League baseball game.

There will be a banquet at 8 p. m. on the closing day, further particulars of which will be given at a later date.

Jovian Electrical League of Southern California.

The weekly luncheon on May 6th was presided over by H. W. Allen. There was a splendid musical program and a lecture by Dr. H. C. Stinchfield of the Southern California Edison Company on "Resuscitation by Manual and Mechanical Methods," and a demonstration of the latter by the use of the pulmotor. The doctor, who has saved the lives of many electrical men receiving severe shocks and burns, reviewed the history of resuscitation, first describing the manual methods of Dr. Sylvester, developed in 1858 and the later or prone pressure method, devised in 1890 by Dr. Schaefer. He pointed out the necessity of attending to the victim at once and not to give up the attempt to save, for persons have been saved after three hours' continuous effort. While the doctor gave high praise to the Draeger Pulmotor, which requires oxygen for its operation, he pointed out the advantage of the new lungmotor, 22 of which have recently been ordered by the Edison Company, which does not require oxygen for its operation. Using Secretary Van Kuren as a subject, the doctor demonstrated the two manual methods and the use of the two machines.

In view of the league's interest in the bond election for the completion of the municipal power plant (held on May 8th), a straw vote was taken with the result that out of 85 votes cast, 80 voted against and 5 for the bonds, which some member explained by crediting three votes to the three Glendale members present and two votes to two Pasadena men present, there being municipal plants in both cities.

Utah Electric Club.

At the regular meeting at the Commercial Club Thursday, May 7th, Lieutenant W. B. Wallace of the U. S. Army read a paper on the subject, "The Regular Army in Times of Peace, and Provisions for Its Expansion at War Times." He pointed out how the regular army as constituted in times of peace is intended to serve only as a nucleus of the war army, and that it is the purpose of the Federal government to educate and train the National Guard of the various states as the first reserve to the regulars in case war is declared. For this purpose, regular army officers are assigned to do inspection and instruction work with the various guard organizations, Lieutenant Wallace himself being attached to the Utah National Guard. The club had as its guests at the luncheon the senior engineering class of the University of Utah with their professors. During the luncheon remarks were made by Professors Knowlton and Beckstrand emphasizing upon the boys the advantage of contact with the men who are actually engaged in commercial pursuits during their course in school.

The entertainment committee announced the spring outing of the club to be held at Lehi thirty miles south of Salt Lake City on the line of the new Orem Interurban, Saturday,

May 16th. There will be a baseball game at Lehi in the afternoon between a picked team from the Electric Club and the Lehi team, which won the championship in the Utah County League last year. Dinner will be served the club by the Lehi Commercial Club at 6 o'clock. A wrestling match and grand ball conclude the day's outing, the return train arriving in Salt Lake City at midnight.

Oregon Hydroelectric Commission.

Professor O. F. Stafford, of the University of Oregon, recenty lectured in the Rosarian room of the Commercial Club at Portland on the possibilities of developing a large iron and steel industry here through utilization of Oregon's tremendous hydroelectric resources. The lecture was given under auspices of the Oregon Hydroelectric Commission, of which H. B. Miller is chairman. The full commission was present. Colonel David M. Dunne, president of the Manufacturers' Association, R. W. Raymond, manager of the association, and the board of nine directors attended also with W. A. Graves, president, and other officers and members of the Oregon Society of Engineers. In prosecuting his work at the University of Oregon, Professor Stafford has made an exhaustive study of hydroelectric resources of the Pacific Northwest, and the application of electrical energy to the great metal industry. He has asked the people of Portland to consider the enormous possibilities when the 12,000,000 or more horsepower of available energy to be had in the Columbia basin has been harnessed and offered suggestions as to what might be done in utilizing this energy. It was stated by the professor that iron ores may be brought to the Portland district from China, Mexico, Chile or even Cuba, when the electric eenrgy is sufficiently cheap, and yet compete with iron plants in the Eastern states.

San Francisco Electrical Development and Jovian League.

After the regular luncheon last Tuesday, the league listened to an intensely practical and masterful talk on the Stevens Bill, now before congress, regulating prices of manufactured commodities and providing for publication of same. It was given by A. E. Roth, a San Francisco attorney. W. F. Neiman occupied the chair.

NEWS OF THE CALIFORNIA RAILROAD COMMISSION.

The commission has rendered a decision authorizing the San Diego Consolidated Gas & Electric Company to renew eleven promissory notes aggregating $373,228.88.

The commission has rendered a decision authorizing an issue of promissory notes in the sum of $2,500,000 by the Pacific Light & Power Corporation. The notes will bear interest at the rate of 6 per cent, payable semi-annually. The new issue of notes authorized will be used to retire outstanding notes in the same sum.

The city of Los Angeles has filed a complaint with the commission against the Southern California Gas Company, the Los Angeles Gas & Electric Corporation, the Southern California Edison Company and the Economic Gas Company, in which it asks the commission to enter an order directing the said companies to supply natural gas to consumers in the city of Los Angeles before using such natural gas which the companies draw from Kern county through their pipe lines in the operation of their own plants, and before diverting any natural gas to other localities away from the city of Los Angeles.

The Sacramento and Woodland Railroad Company and the Northern Electric Railway Company have joined in an application filed with the commission, asking for an order authorizing an agreement by which the Sacramento & Woodland Railroad Company will be operated by the Northern Electric Railway Company.

The commission has rendered a decision authorizing the Roseville Home Telephone Company of Roseville, Placer county, to transfer its system to the Roseville Telephone Company for $11,000 in stock of the latter company.

The commission has rendered a decision granting authority to the Mt. Whitney Power & Electric Company to issue $500,000, of its 6 per cent 30 year bonds. The bonds are to be sold so as to net the applicant 95 per cent of the par value plus accrued interest.

EXAMINATION FOR ELECTRICAL ENGINEER AND DRAFTSMAN.

The United States Civil Service Commission announces an open competitive examination for electrical engineer and draftsman, on June 3 and 4, 1914. From the register of eligibles resulting from this examination certification will be made to fill vacancies as they may occur in this position, at $1200 per annum, in the office of the supervising architect, Treasury Department, Washington, D. C. Applicants must have a good common school or high schol education and not less than three years' special experience as a draftsman principally in connection with electrical work, or be technical graduates with not less than ten months' experience as electrical draftsman or practical experience in the installation of electrical wiring or apparatus. A rating of at least 70 per cent in this subject is a prerequisite for consideration for this position. Competitors will be furnished with whatever drawing paper and tracing vellum may be necessary, but they must supply themselves with drawing boards not less than 18 inches square and all other drawing instruments and materials which they deem necessary. Age, 22 years or over on the date of the examination.

Under an act of Congress applicants for this position must be examined in the state or territory in which they reside and have been actually domiciled in such state or territory for at least one year previous to the date of the examination. Persons who meet the requirements and desire this examination should at once apply for Form 1312, to the United States Civil Service Commission, Washington, D. C.

TRADE NOTES.

The Bay Cities Engineering Company completed the feeder and trolley work in connection with the Union Street Municipal Line, San Francisco, no less than 19 days ahead of schedule although no bonus was offered for early completion. This will enable the municipality to at once connect up with the central station supply and so results in a further saving to the city.

Among recent orders obtained by the San Francisco office of Allis-Chalmers Manufacturing Company are two large motors for the California Street Cable Railway, a 1500 kw. turbo generator set, complete with condensers, etc., as well as the complete motor equipment of the new planing mill of the Pacific Lumber Company at Scotia, Cal.; and a complete pumping plant for the South Coast Land Company at Oceanside, Cal.

NEW CATALOGUES.

Westinghouse Electric Type I Oil Switches. Leaflet 3745 describes and illustrates the construction of this type of oil switch which is intended for use on direct or alternating current series lighting circuits and for controlling inductive loads of small capacity.

Leaflet 3512-A describes Westinghouse Electric Auto-Starter for Squirrel Cage Motors. The construction of this device is fully described and illustrated as is also the overload relay with which it is equipped. No. 2364 describes Westinghouse Electric d.c. type K Crane Motors. These motors are designed for severe intermittent, varying speed service where high torque is required such as cranes, hoists, coke charging machines, etc. Complete and detailed views of the motors are given and the more important features of construction described. Folder 4172 describes the Westinghouse Bell Ringing Transformer and shows how it should be installed.

NEWS NOTES

INCORPORATIONS.

PARKLAND, WASH.—The Parkland Light & Water Company has been incorporated.

WALLA WALLA, WASH.—The Walla Walla River Power Company has filed articles of incorporation for $120,000. They plan to start within a few months the construction of a power plant for developing 1800 h.p.

RENO, NEV.—Articles of incorporation naming Reno as the principal place of business have been filed for the Beaver River Power & Plant Company. Wide powers are granted in the articles. The capital stock is $100,000, divided into 100,000 shares. The articles are witnessed in Ada county, Idaho, and name as subscribers to stock H. R. Waldo, Geo. F. Halliday, O. P. McBiersach, E. P. Bacon and H. V. Hoyt.

ILLUMINATION.

AUBURN, WASH.—The Auburn Gas Company has applied for a franchise. Estimated cost of laying mains is $30,000.

EL PASO, TEX.—Plans for the erection of a new gas plant are being considered by the El Paso Gas & Electric Company.

HUNTINGTON PARK, CAL.—The city trustees have rejected all bids for lighting posts and will enter upon the market to buy.

MARTINEZ, CAL.—The Pacific Gas & Electric Company has been awarded the franchise it recently applied for along certain public roads in the vicinity of Stege.

AVALON, CAL.—Private capital is ready to install a gas plant here and application has been received by the board of trustees for a franchise, the plant to be in operation by July 15th.

REDLANDS, CAL.—The city trustees granted a contract to the Independent Electric Company for the extension of the ornamental street lighting system on Orange street from Colton to Lugonia avenue, for $1250.

SEATTLE, WASH.—The city council has passed resolutions providing for the improvement of Madison street, Marion street and Columbia street each from Railroad avenue to First avenue by the installation of cluster lights.

COVINA, CAL.—The board of trustees will receive bids up to May 19th, for furnishing and installing ornamental pressed steel and copper posts with cast iron base and concrete foundation on Badillo and Citrus avenues, ninety posts in all to be placed, fully equipped for street lighting purposes.

CHEHALIS, WASH.—Ben Walling Jr., claiming to represent capital to build a power plant capable of supplying southwest Washington cities with electric power at much lower rates than they are getting at present, has applied for a franchise. The city commission will submit the proposition to a vote of the people.

STOCKTON, CAL.—The state supreme court has granted a rehearing of the case in which it recently reversed a decision of the railroad commission shutting the Oro Electric Corporation out of this city on the grounds that it was adequately served by the Western States Gas & Electric Company. The Oro corporation protested against a rehearing, while many other power companies supported the petition of the commission for a re-opening of the case.

LOS ANGELES, CAL.—The city has voted to issue $6,500,000 bonds to build a plant to develop power from the Los Angeles aqueduct and to acquire a distributing system which will furnish most of the light and power used in the city. The vote was 56,199 to 23,179 in favor of the bonds. Of the money voted $1,250,000 will be devoted to equipping the plant, which will generate its power by means of the water brought in the aqueduct from the Sierra Nevada mountains.

SALT LAKE CITY, UTAH.—Eugene B. Palmer, handling the advertising of Walker Brothers, bankers, of Salt Lake City, in an address before the Salt Lake Ad Club on the subject, "New Applications of Advertising," commended the Salt Lake public utilites, particularly the telephone company and the Utah Light & Railway Company on the progressive advertising policy which they were pursuing. As an illustration of timeliness in advertising, he threw on the screen a slide of an advertisement run by the Utah Light & Railway Company the day following the attempt of the black hand gang in Ogden to blow up the residence of David Eccles by planting a dynamite bomb under the front porch. The advertisement depicted a front porch light thrown on and a suspicious looking character slinking away into the bushes to escape the light, and was headed, "Burglars and Blackhanders Shun the Light." The reading matter pointed out how this attempt to destroy life and property could have been avoided by the regular burning of a porch light each night.

TRANSMISSION.

MONETA, CAL.—The Southern California Edison Company has purchased a lot at Western avenue and Gladstone street, for the establishment of a substation to facilitate handling of high tension current passing along Western avenue, and to establish a distributing station.

SANTA MONICA, CAL.—In the development work and ultimately for all domestic purposes, electricity will be the only power used in the new 20,000 acre residence tract at Santa Monica Park. Thirty-five miles of road are to be built.

MOAB, UTAH.—Messrs. C. A. Hammond of this city and Joseph W. Christensen of Fairview, have under consideration the installation of an electric lighting plant in this city. A. V. Richards, of the engineering firm of Caldwell and Richards of Salt Lake City, has been in Moab for the past week for the purpose of making an estimate of the cost to install a plant. Mr. Richards has also made preliminary surveys and estimates for the installation of a plant at Monticello.

CHICO, CAL.—Paying the $16,000 more than the price of the option it held three years ago, but allowed to lapse, the Great Western Power Company has settled with Jacob Moak, a pioneer Chico and Plumas county stockman, for $36,000 for his 160 acre ranch at Big Meadows, which is now covered with water. This ranch is the last piece of land bought by the company on the 26,000 acre tract covered by its great natural reservoir which recently was filled with water.

FALL RIVER MILLS, CAL.—The California Power & Manufacturing Company, which recently bought the local electric power plant and obtained a franchise for developing power also from water in Hat Creek, announces that it expects to be able to serve electric current for all purposes to consumers in Fall River Valley by July 1st. Plans have been accepted for the new power plant that will be located

near Pit River, just below the Florin flour mill. A large number of contracts for electric power have been signed up. A power line to Greenburn is almost completed.

VISALIA, CAL.—Formal acceptance by the state officials of the new boundary between Fresno and Tulare counties, as established recently by a joint survey, removes the final obstacle to a suit which the district attorney has been instructed to bring against the Pacific Light & Power Company to compel them to make certain changes in the construction of their transmission lines through this county. It is claimed that the corporation, in building this line, which extends from Crane Valley to Los Angeles, violated the regulations with regard to height of towers and distance these towers are spaced.

BISHOP, CAL.—General Manager Chappelle and Chief Engineer Poole, of the Nevada-California and allied companies, was here recently on a brief inspection of power affairs. Mr. Chappelle stated that the company's present intention is to begin work on Plant 1, on Bishop Creek, this year. It is not expected that the undertaking can be finished before next fall's snows come, but much of the heaviest construction work will have been accomplished by that time. This plant will be the largest of all on the stream. It will contain but one unit, but that will be of 10,000 kw. units in power, as compared with the 2200 kw. units in groups in the other plants. The first intention was to build another plant, A, still further up, but the decision has been reached to concentrate the outlay in plant 1. Its location will be at the intake. Flow lines will come from South Lake and Sabrina, with great fall, each line discharging against its own separate wheel but both connected to the same big generator.

SPOKANE, WASH.—The Washington Water Power Company has purchased the power transmission lines of the Lewiston-Clarkston Improvement Company from Leon Station, Nez Perce County, Idaho, to Moscow, Pullman, Uniontown, Genesee and Colton. The lines were contructed by the Lewiston-Clarkston Improvement Company ten years ago to supply power at wholesale to the local distributing systems of the towns mentioned. The local lines in Uniontown, Moscow, Genesee and Pullman were originally owned by the Shields-McGowan interests of Moscow, and were purchased last summer by the Washington Water Power Company. Since the sale was made the Lewiston-Clarkston Improvement Company has continued to furnish power for the local systems in the towns referred to and will continue the service until the Washington Water Power Company can complete the extensions necessary to enable it to serve the territory, probably on or about June 1. Surveys have been made to Troy, Kendrick and Julietta and it is likely that a line will be built into that territory.

TRANSPORTATION.

PORTLAND, ORE.—The Pacific Power & Light Company will start construction at once of an extension of local car lines around Smith's point to Hammond Mill, Astoria, Oregon. T. W. Talbot of Portland, is president of this company.

MILWAUKEE, WASH.—Louis H. Campbell, a civil engineer of this city, has applied to the council for a 25 year street railway franchise over practically every improved street in the town between the downtown district and the eastern town limits.

LOS ANGELES, CAL.—For the purpose of determining rights of the Pacific Electric and other railroad companies within the city to spur track privileges under franchises for main lines granted by the county before the districts become annexed to the city, the board of utilities has requested the city attorney to bring suit in case of the Simons Brick Company's spur.

VALLEJO, CAL.—The Northern Electric Railway Company is preparing to resume operations in this city. It is announced that a large quantity of ties and rails are to be shipped here during the present month and that a track laying machine will be brought here and used in laying the tracks north from this city. The grading operations in the cut have been completed for several weeks.

SAN FRANCISCO, CAL.—The board of works has awarded to Eaton & Smith the contract for building the Potrero avenue municipal railway line for $143,767. The construction of the track and conduits is to be completed within 120 days from the date of signing the contract. By finishing ahead of the time allowed, the contractors can earn a bonus of $400 a day for 30 days. It is expected the line will be ready for operation toward the end of August or early in September, when the running of cars on the Van Ness avenue line, with which it will connect, is to begin.

DIXON, CAL.—The Sacramento Valley Electric Railway Company has begun laying rails from the Oakland & Antioch junction, 12 miles southeast of here, toward Dixon. Only half a mile of rails can be laid before a temporary halt will have to be made while a bridge 345 ft. long is constructed. The piling for the bridge will be hauled over this half mile of track. Grading to Dixon will be finished within two weeks, is the word of General Manager Melville Dozier. The road will be in operation in July, he says, between the Junction and Dixon. Dozier has been made consulting engineer of the Oakland & Antioch.

SAN FRANCISCO, CAL.—Bids for the construction of the Potrero avenue municipal railway line, which will connect with the Van Ness avenue line at Market street, and will run along Eleventh street and Potrero avenue to Twenty-fifth street, have been opened by the board of public works. The lowest of the five was filed by a new firm of contractors, consisting of Clarence B. Eaton and James Smith, former employes of the public works department. The figuring was close, the firms and their bids being as follows: Eaton & Smith, $134,767.80; Mahoney Bros., $137,432.80; R. C. Storrie, $138,474.50; F. Rolandi, $145,476.50; Healy m Tibbitts, $151,-310. The city engineer's estimate, including a possible bonus of $9,000 for the work, was $142,200.

SAN FRANCISCO, CAL.—At the annual meeting of the United Railways Investment Company, the holding corporation for the United Railroads of San Francisco, Patrick Calhoun, George E. Shaw and Sydney H. March resigned as directors, their places being filled by the election of Alexander J. Hemphill, W. H. Chesebrough and H. J. Miller. There was prolonged discussion accompanied by many objections and suggested amendments to the plan of reorganization of the company. After three hours of argument, a resolution contemplated under the plan providing for the creation of an agency of nine members of either effecting the plan or making such modifications of it as it deemed necessary was passed by the stockholders, with a vote of 143,396 common shares and 81,398 preferred shares.

SAN MATEO, CAL.—The plans of San Mateo citizens to build their own electric line down the peninsula were brought another step nearer consummation when the articles of incorporation of the San Francisco-San Mateo Right of Way Company were adopted. The company is organized to secure a right of way for an electric line from San Francisco to peninsula points which will either be sold to a railroad company to build a system or retained for the people's own electric line. The following directorate has been elected: M. R. Johnson of Montara, president of the San Mateo County Development Association; H. C. Tuchsen, trustee of Redwood City; Torrence Masterson, trustee of San Mateo; D. G. Doubleday of Millbrae; F. A. Cunningham, ex-Mayor of South San Francisco; E. M. Moores, mayor of Burlingame, Rev. W. A. Brewer, mayor of Hillsborough.